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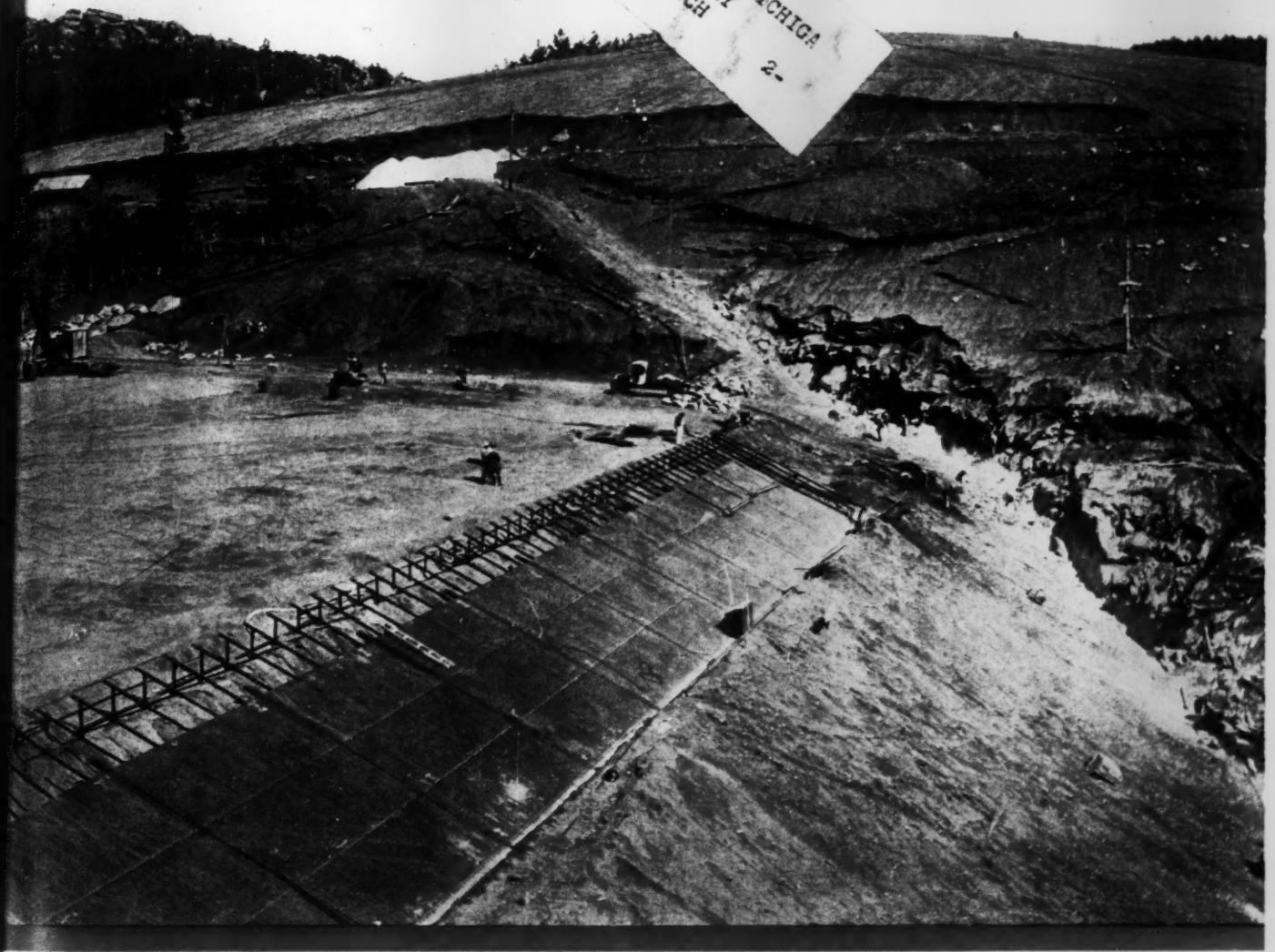

Steel facing being erected on new dam for Colorado Springs water supply. Earth fill and facing of twenty lines of sheets are raised together. A concrete slab covers the lower slope

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Glass Block Windows in a Factory Building

Second Steel Faced Dam for Colorado Springs

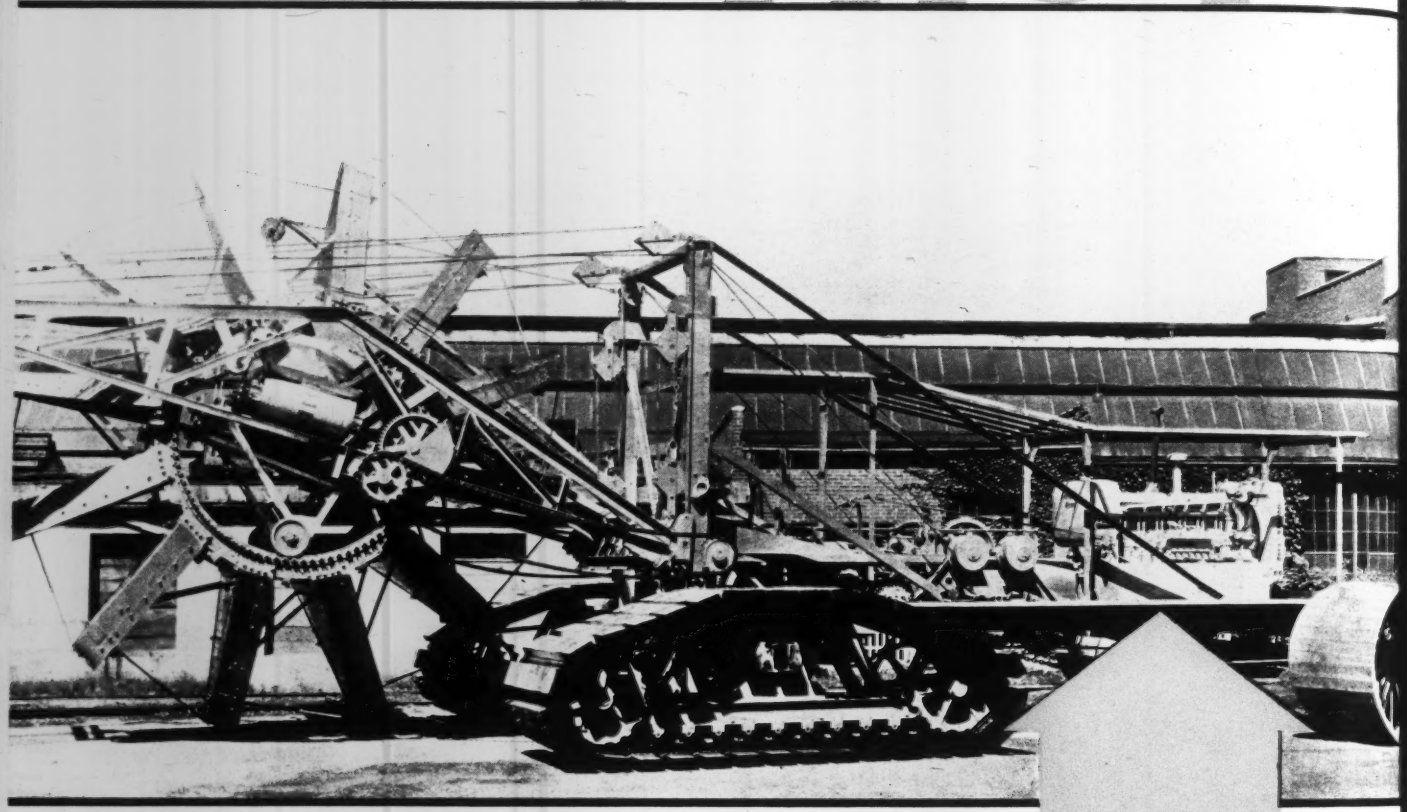
Highways and Structural Alloys at A.S.C.E. Meeting

The Future of Federal Highway Aid

By H. G. SHIRLEY

BUCKEYE

DIGS WITH THE POWER THAT'S FIRST



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The DISTRIBUTOR and *Industrial Efficiency*

CONSTANTLY we are reminded that if we are to reap the full benefit of our technical progress we must devote to the process of exchanging our products an increasing measure of the genius that we have poured into the production function.

Exchange, more commonly called distribution, involves several factors. Finance is one of them. Merchandising is another. Advertising, as a special function of merchandising, rates high in the scale. Swift and flexible transportation is important. Some of these factors have to do with intangibles, i.e., they provide for the flow of ideas and information concerning goods and services and for the financial accomodation required by trade.

But aside from all these, is the very concrete problem of maintaining, on an adequate and economical basis, the actual physical flow of goods and services. In a country so vast as ours, consolidated into a single economic area, this becomes an exacting administrative task. Ever since the United States embarked upon its present course of high industrial productivity, producers and consumers alike have been grappling with it. Industry has experimented with many devices by which to master it. Singly and by industries, more and more producers have come to study their markets and the use of their products in those markets in order to devise in each case a sound distribution policy.

Not least important among the agencies that have won a recognized place in this vital function of distribution is that clearing house for industrial equipment and service that we call the distributor. In the construction industry he is the "equipment distributor," usually handling, within a limited geographical area, the products and services of a number of manufacturers. It would be difficult to imagine the modern construction industry, with its rapidly developing technique and equipment, without these distributors.

GENERALLY speaking, manufacturers are quite conscious of the distributor's service and value, but many consumers still cherish the notion that all so-called middlemen are non-productive burdens to be carried on the backs of the producers and consumers.

To help dispel that mistaken notion, wherever held, *Mill Supplies* has devoted its September issue to a survey of the values created by the responsible industrial distributor. In the interest of more widespread understanding of an important subject, it is to be hoped that this presentation may reach many consumers of industrial products as well as the manufacturers to whom it is more directly addressed.

Among the values created by the capable equipment distributor, *Mill Supplies* lists those savings that are made possible by centralized buying from local stocks maintained at low cost to the manufacturer; prompter and more flexible delivery to meet consumer needs; more regular and economical sales contacts through compact and consolidated sales organizations, having a close and personal service contact with users and thereby adding a local guarantor of satisfactory performance.

THESE are but typical of the values offered by the distributor not only to the producer who may use his services but also to the entire industrial community. And that includes every consumer of any product produced by the American industrial organism. Distribution costs always must be included in the ultimate cost to the consumer; when the distributor helps the producer to put his product into the hands of his customer at a lower cost in cash, time, convenience or general efficiency, he is making a substantial contribution toward the more satisfactory operation of the whole economic machine. For several reasons that need not be rehearsed here, this is especially true of the construction industry.

To harmonize more effectively the efficiency of exchange with that of production, we must continue our attack on the financial and merchandising aspects of the problem. But while we are doing this, we dare not forget the equally important requirement that we handle ever more efficiently the flow of the actual goods and services themselves from the producer's factory into the hands of his customers.

Willard Chevalier

ENGINEERING NEWS-RECORD Published every Thursday. Vol. 117, No. 18. Price 25c. per copy. Subscription, domestic, Canada, Mexico, Central and South American countries, $5 per year. All other countries $9 a year or 36 shillings. Application for entry as second-class matter at Albany, N. Y., pending. Printed in U. S. A. Cable address "McGrawhill New York." Member A.B.P. Member A.B.C.

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Editorial and Executive Offices: 330 West 42d St., New York. Publication Office: 99-129 N. Broadway, Albany, N. Y. Branch Offices: 520 N. Michigan Ave., Chicago; 883 Mission St., San Francisco; Aldwych House, London, W. C. 2, England; Washington; Philadelphia; Cleveland; Detroit; St. Louis; Boston; Atlanta, Ga.

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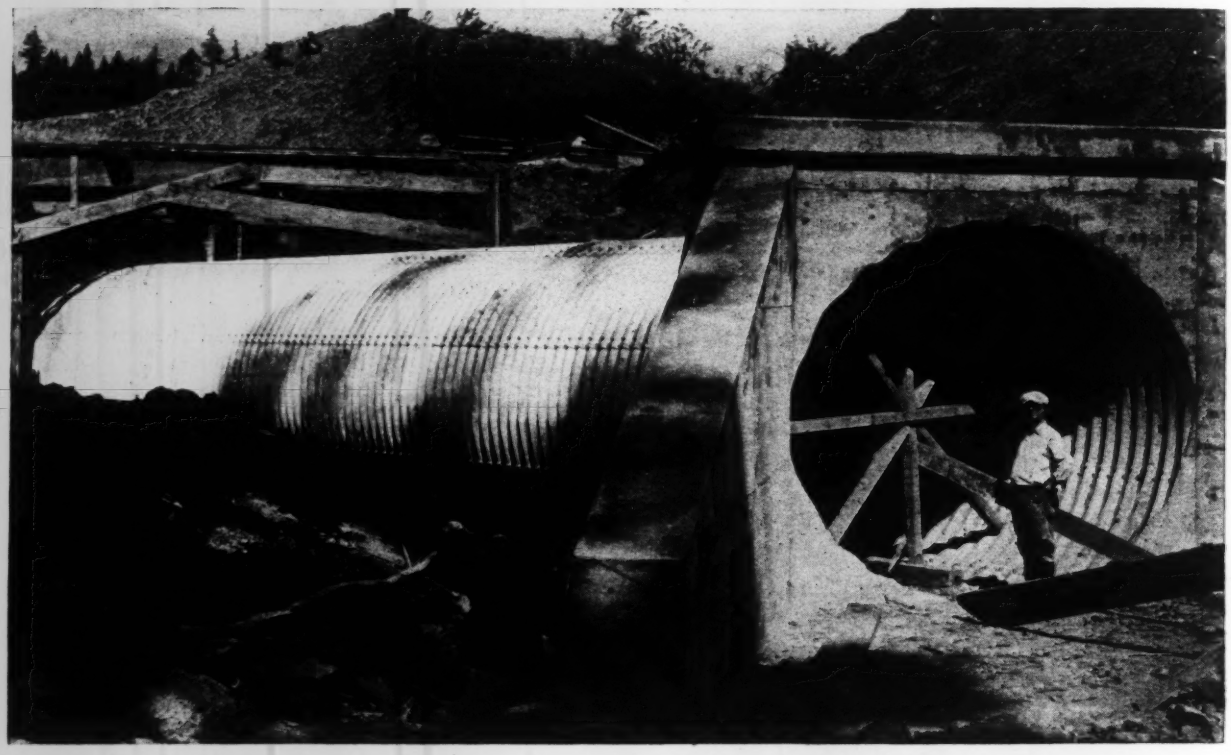
Desert Conduits—Experience in Building the cut-and-cover conduits of the Colorado River Aqueduct has justified the precautions taken in the design to resist the severe temperature conditions of desert construction. What these experiences have been is related in a significant article to be published in next week's issue.

For Better Drainage Structures at Lower Cost . . .

American Sectional Plates



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ENGINEERING NEWS-RECORD

October 29, 1936

FIG. 1—SOUTH CATAMOUNT CREEK DAM is a fill of disintegrated granite faced with a combination of a concrete slab and welded steel plates. Here shown are the initial three sections of the steel face. The reinforced concrete slab on the lower slope has been covered for curing.

Second Steel-Faced Dam Built for Colorado Springs

Two new dams on north slope of Pikes Peak add water storage to meet needs until 1960—Steel faceplates are set on light steel frames and welded into one piece

THE SECOND of two closely located steel-faced dams for the storage of water on the north slope of Pikes Peak for Colorado Springs is well on the way to completion. Like the Crystal Creek dam which was completed in 1935 the Catamount Creek dam is a fill of disintegrated granite faced in major part with steel plates; the remainder of the face is a reinforced concrete slab which extends to a concrete cutoff toewall carried down into solid rock. With minor exceptions the two structures, which dam adjacent streams to essentially the same elevation, are quite similar in design and construction. In each case a concrete-lined spillway will carry the overflow around the left end of the dam and the outlet is a concrete tunnel in which are laid two steel outlet pipes.

Interest in the dam centers around the steel face and method of placing the sheets on steel frames simultaneous with the fill. The pipeline to the city reservoirs is novel in that there are no siphons and the maximum head reaches 1,909 ft. which, since it is not yet needed for power, must be dissipated before entering the city distribution system.

Colorado Springs, a city of 38,000 people, has a summer tourist population which doubles its census population. It derives water by gravity from the slopes of Pikes Peak. From the high heads available, power is developed as required to meet the needs of the city. Supplying power and water as well as gas are municipal enterprises.

Until recently the water supply has come mainly from the south slope, furnishing in 1935, an average 6.7 m.g.d., equivalent to 180 gal. per capita of the census population. This is 28 gal. less than was used in 1934; 52 gal. less than in 1932 and 1933, and 73 gal. less than in 1931, the smaller quantity reflecting the restrictions placed on users. These restrictions had to be enforced largely through inspections because only 6.13 per cent of the services are metered.

The drought of 1934 accelerated the movement to get more storage by the developments on the north slope, the south slope watershed of 38.4 sq. mi. having already been developed to the limit. Years ago the city obtained flowage and storage rights from the federal government by act of Congress for water on 27.2 sq. mi. of forest preserve areas on the north slope. The water

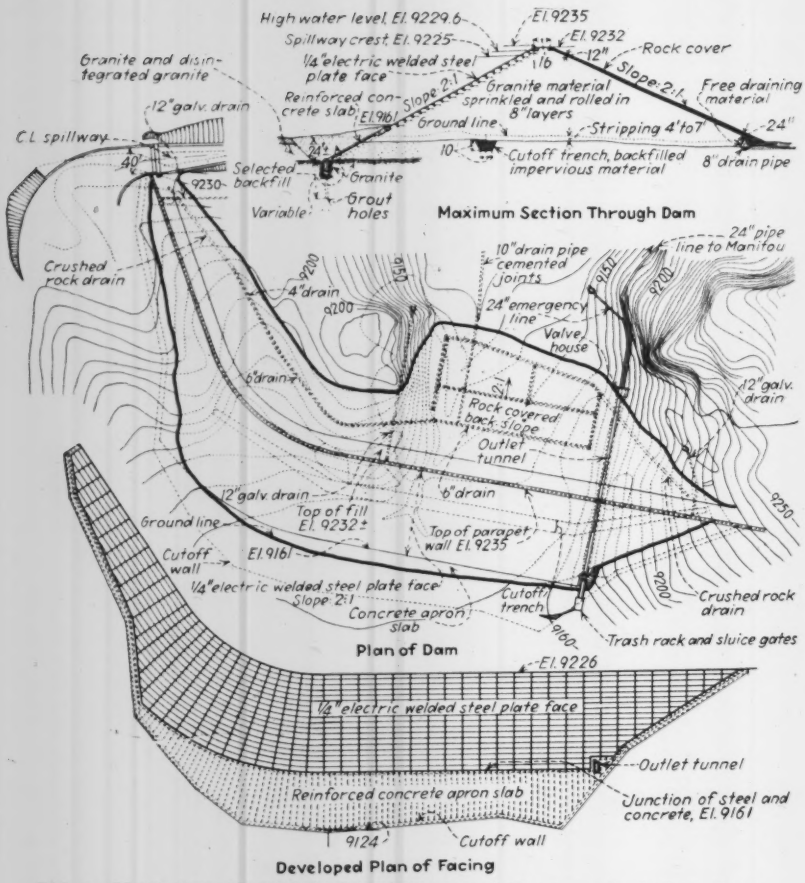
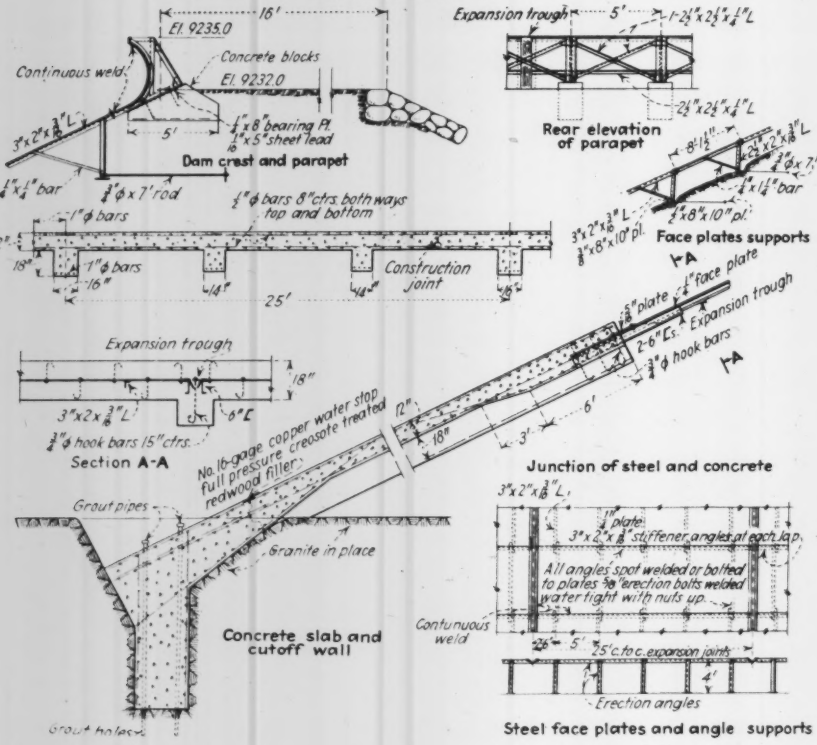


FIG. 2—PLAN AND MAXIMUM SECTION of South Catamount Creek Dam, also a developed plan of the facing.

FIG. 3—THE FACING OF THE DAM is a combination of a reinforced concrete slab and welded steel plates.



available from this development is estimated at 6 m.g.d. average throughout the year and 15 m.g.d. maximum. Together with the south slope water it will care for the 100,000 people expected in 1960. When all the water under the rights obtained has been utilized metering will be actively promoted.

Crystal Creek and Catamount Creek watersheds are 3.5 and 6.1 sq. mi. respectively of the north slope area granted by the government; the remainder is contributary as direct flow to Cascade Creek and French Creek where it is picked up at lower levels. The capacities of the two north slope reservoirs are 3,500 acre-ft. for the Crystal Creek reservoir and 2,500 acre-ft. for Catamount reservoir. Runoffs from these high areas range from 20 to 24 in. annually of which nearly 5 in. is usually realized in July. Basing calculations on records back to 1891 on the south slope, where the annual rainfall is 2 to 4 ft. it was estimated that the 2,265 acres of drainage area of the Crystal Creek watershed would produce enough runoff to fill the 3,500 acre-ft. reservoir in 4.7 years, but if the Catamount dam were built so as to obtain the benefit of equalization on the combined watersheds and storage the reservoirs could be filled in 3 years. For this reason the two dams were authorized and a grant of $412,000 from PWA successfully solicited. Water revenue bonds bearing an average of 3.36 per cent were sold for $1,100,000 and the remainder of the $1,770,000 total cost will come from emergency short term financing and from operating revenues.

Investment costs

The investment cost per acre-ft. of storage capacity of the Crystal Creek dam and reservoir is $121, and the cost per acre-ft. of annual water yield is $563. For the Catamount Creek dam and reservoir similar costs are $240 and $468, respectively, and for the combined projects having an estimated net annual water yield of 2,032 acre-ft. the cost per acre-ft. of storage is $170 and cost per acre-ft. of annual water yield is $503.

To Jan. 1, $1,284,000 had been spent on the north slope development which included the completed Crystal Creek dam and all the pipelines and tunnels for both dams. Completion of the line to the Catamount Creek dam permitted taking the direct-flow water diverted around the construction operation into the line leading to the city.

Briefly, the north slope development comprises the two dams located 15 mi. west of the city on the Pikes Peak auto highway; 9.43 miles of 20- and 24-in. steel pipe, 5/16 to 11/16 in. thick, skirting steep cliffs and slopes leading through the Cascade hydro unit, where the pressure is 1,000 lb. per sq. in., to the Manitou hydro plant where

the pressure is 300 lb. at an elevation more than 2,500 ft. below the dam outlets. In the line are nine tunnels, aggregating 13,794 ft., within which the pipes are laid. To kill the unused head by reason of the fall from the Cascade plant to Manitou a nozzle head-reducer is inserted in the end of the line.

Crossing of canyons and depressions is by concrete piers and steel bents, the pipe acting as a bridge. Other features on the line include blowoffs, air valves and concrete anchors of novel design at sharp bends. The following notes relate principally to the special features of the dams, such as steel face, cutoff toewall, grouting, embankment compaction, spillway, outlets and construction.

South Catamount Creek Dam

The design of Catamount Creek Dam, with its steel upstream face, downstream rock cover, cutoff trench, granitic gravel embankment, upstream concrete toewall built in an excavation of the gravel overlying the rock and concrete slab connecting the toewall with the steel face, is shown in the drawings.

The steel face is made up of single sheets, 8 ft. 4 in. wide and 24 ft. 5 in. long, laid with the long dimension parallel to the axis of the dam. Expansion is provided at the ends of the sheets by a U-shaped steel trough running up and down the slope. This makes the dimension between expansion troughs 25 ft. center to center. Both the lap joints and those at the expansion troughs are a continuous electric weld making the whole face of the dam a single sheet. Some bulging and warping takes place.

The upper edge of the face on Catamount Creek dam is finished in a curved steel wave breaker having a sliding bearing on the concrete blocks that support it. The face at the Crystal Creek dam ends in a sliding joint anchored to the concrete base of the parapet wall permitting an expansion of 6 in. The movement at the top, however, is not great and bulging on three other similar steel-faced dams in the intermountain country have not been detrimental to the integrity of the face. One of them, owned by a power company near Victor, Colo., is 46 years old and it has *no* expansion joints.

The plates are put in place on light steel frames by a special erecting crane mounted on a tractor. The frames are anchored back into the fill which is brought up simultaneously with the laying of the plates, a space of 3 ft. being left under the plates so that the latter may be painted after they are placed and welded. Thereafter the 3-ft. space is filled with gravel and hand tamped, care being taken not to bulge the plates, as is easily done if pneumatic tampers are employed.

The plates are secured to the supporting frames by bolts which latter are welded. Spot welding to the frames also is done. The frames and both sides of the plates are painted with red lead. The underside painting is done just before backfilling. Aluminum paint was used on the exposed face of Crystal Creek dam but a gray oil paint (19 lb. of white lead to 1 gal. of linseed oil) is being used on the face of the Catamount Creek dam as it absorbs less heat. All paint is applied by brush. When necessary to paint in cold weather, paint is required to be heated to 130 to 150 deg. Fahr.

The plates are shop painted with a thin coat of linseed oil to protect them from rust. This thin oiling does not interfere with the welding.

For operating the direct current generators for the welders the contractor utilizes current obtained from a nearby city power line carrying current at 6,600 volts. The shielded-arc process was specified, using automatic welding machines. Electrodes of mild steel were specified having the following chemical composition: Carbon, 0.13 to 0.18 per cent; manganese, 0.4 to 0.6 per cent; phosphorus and silicon each not over 0.6 per cent. The rods were heavily coated with material which would protect the weld deposit during deposition. Only experienced welders were permitted on the job. The qualification tests were those set up by the American Bureau of Welding.

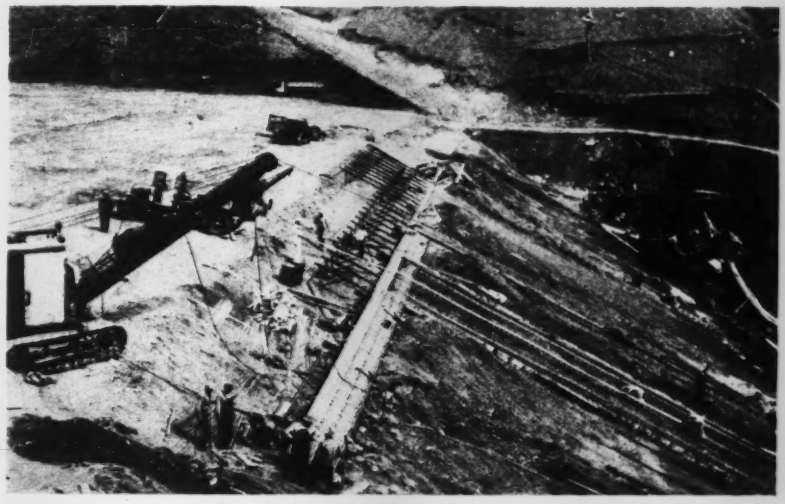


FIG. 4—THE LOWER SLOPE of the face of the dam from the cutoff trench up to about ground line is covered with a reinforced concrete slab laid on the completed fill. This view shows the slab under construction, also, in the center, the diaphragm connecting the slab to the steel face and above it the supports for steel faceplates.

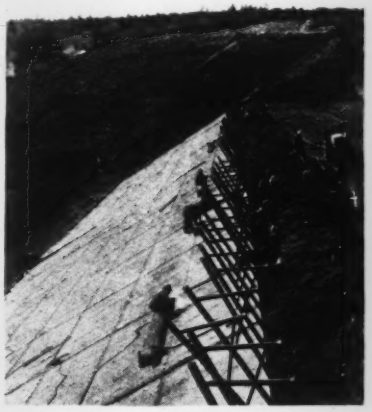


FIG. 5—FILLING under the face plates is facilitated by turning back the deck supports. The work is done by hand.

FIG. 6 — FACE PLATES are swung over the side and lowered to position by a small crane rigged up on a tractor.

Concrete face slab

The lower edge of the steel deck ends at El. 9,160, which is the same elevation as the invert of the discharge gate chamber and about 10 ft. above natural ground level at the creek flood plane. From this point down to the toewall is a heavily reinforced concrete apron slab, 12 in. thick. The steel face extends 3 ft. into the concrete and is

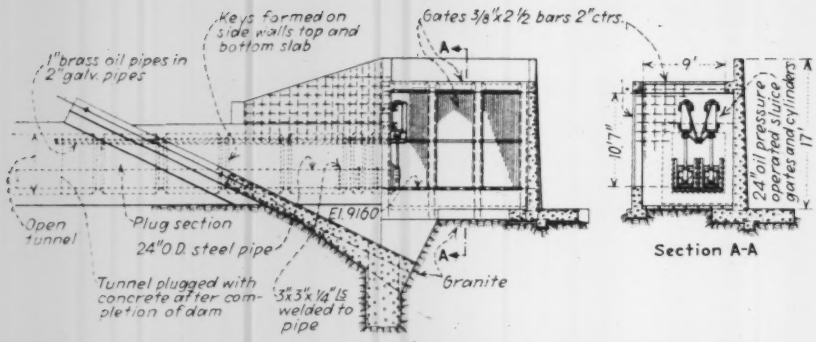


FIG. 7—SLUICE GATES that control the flow from the reservoir are located within an intake structure at the upper end of the pipe tunnel through the dam. The valves are controlled from a valve house below the dam.

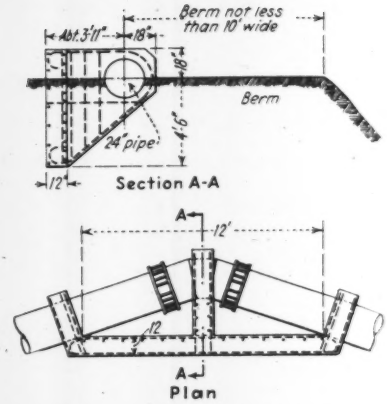


FIG. 9—REINFORCED CONCRETE ANCHORAGE for a pipe bend in gravel where the resultant acts toward the downhill slope.

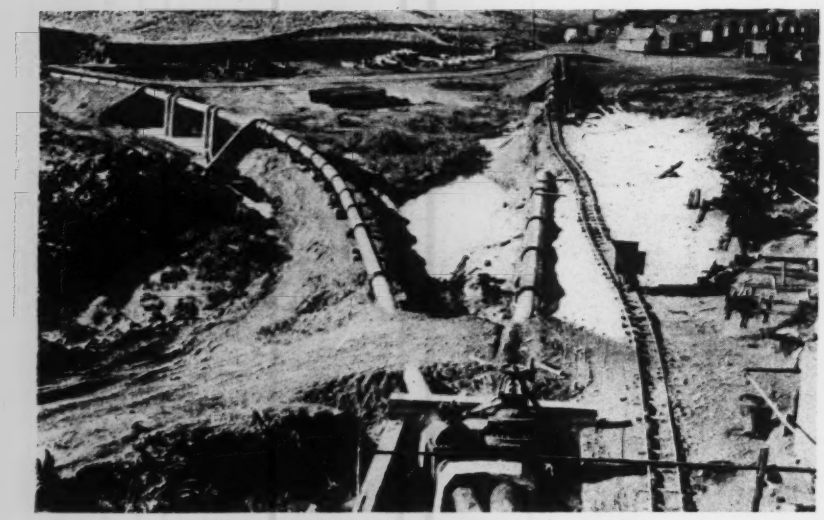


FIG. 8—JUNCTION OF PIPE LINES from Cyrstal Creek (left) and Catamount Creek. Permanent openings under the pipe lines are to pass emergency and spillway discharges from Crystal Creek Dam.

stiffened at the expansion joint with two 6-in. channels but the expansion joint does not extend into the concrete.

Below the apron slab and integral with it is the cutoff extending through the decomposed granite to solid rock. In this trench, which varies from 15 to 25 ft. in depth, 2-in. grout pipes are set prior to placing concrete. These pipes are placed 10 ft. apart on each side of the trench staggered so that there is grouting every 5 ft. Grout holes 1 in. in diameter are drilled through these pipes. The criteria of when to stop drilling are entrance into solid gray granite indicated by the cores and the 40 to 100-lb. pressure reaction from grouting.

Holes in the Crystal Creek toe generally ran 50 ft. deep for a horizontal distance of 300 ft. across the valley floor. The deepest was 100 ft. and the hole requiring the greatest amount of grout (50 bbl. of cement) was only 38 ft. deep. There was a total of 195 holes aggregating 7,278 lin. ft. in depth requiring grout containing 1,820 bbl. of cement. Though similar materials are being encountered under the toewall of the Catamount Creek dam it is not expected that many of the grout holes will exceed 25 ft. in depth.

The cutoff wall continues up the abutments to the spillway and under the crest. Grouting is also continued under the spillway.

Fill construction

The base of the dam was stripped of 4 to 7 ft. of topsoil prior to hauling in the decomposed granite embankment material. Similarly the borrow pits, 500 ft. distant, were stripped, mostly with bulldozers. As one of the preliminary operations, a cutoff trench, 10 ft. deep and 50 ft. upstream from the axis of the dam, was excavated and filled with impervious material, sprinkled and rolled in 8-in. layers.

Embankment material was brought in with 5-yd. trucks and 9-yd. trailers, spread by bulldozers to produce 8-in. layers after sprinkling and rolling with at least three passes of a car-wheel roller weighing 3,000 lb. per lineal foot. A roller weighing 2,000 lb. per foot was tried on the Crystal Creek dam but did not give the maximum compaction. A moisture of 10 per cent was used to obtain density. Pneumatic tampers are used in close quarters, close to rock and around the outlet conduit.

Many tests on the decomposed red granite, soils and clays near the dams were made at the University of Colorado to determine the best size of material and the relation between vertical pressure and coefficient of internal friction, both dry and wet (10 per cent moisture). The co-efficient becomes approximately constant, ranging from 0.7 to 0.8, at a pressure of from 40 to 50 lb. with the broken and disintegrated red granite when it contains 10 per cent of moisture. Ten per cent moisture is the amount aimed at in the sprinkling program.

The spillway crest is 7 ft. below the top of the dam and is designed to carry 1,200 sec.-ft., equivalent to 200 sec.-ft. per sq. mi. of drainage area, with 4.6 ft. head. Records in the area indicate 100 sec.-ft. per sq. mi. of runoff may be expected. The spillway channel narrows from 40 ft. at the spillway crest to 15 ft. in 165 ft. The vertical side walls range from 12 ft. high at the inlet to 5 ft. at the lower end. Expansion joints of 1/2-in. bituminous felt with a copper water stop are inserted every 20 ft. A 6-in. tile drain is laid under the 8-in. floor slab.

The outlet works of the Catamount Creek dam consist of a concrete inlet structure with trash rack of 3/4-in. bars spaced on 2-in. centers on top and one side providing a total opening of 178 sq. ft. or 59 times the area of one of the 24-in. sluice gates. At 3-ft. velocity through the gate thus gives a velocity through the bars of 0.05 ft. per sec. The inlet is a concrete box, 15 ft. long, 9 ft. wide and 17 ft. high. It is placed with the floor at El. 9,157, 10 ft. above the flood plain and 2-1/2 ft. below the invert of the outlet pipes which have a 0.5 per cent grade to connect with the line coming from Crystal Creek reservoir. After the tunnel was lined the two 24-in. pipes

were laid on the floor and a concrete plug 36 ft. long was placed in the upstream end of the tunnel. Four 1-in. brass pipes controlling the operation of the 24-in. hydraulically operated sluice gates in the intake lead from that structure through the tunnel to the operating pump and tanks in the gate house at the downstream toe of the dam. The brass pipes are incased in 2-in. galvanized-iron pipes and are hung from the roof slab of the tunnel lining. The tunnel is rectangular in form, 5 ft. 9 in. wide and 6 ft. 9 in. high. Top and bottom slabs are 16 in. thick and side walls 12 in. Six heavy cutoff collars are placed around the tunnel.

One of the two pipelines within the tunnel is for emergency and to discharge water into the creek below the dam; the other, after joining the line from the Crystal Creek reservoir, leads to Manitou.

The contractor must maintain all roads used; only during designated hours can he use the Pikes Peak Auto Highway, formerly a toll road, maintenance of which has recently been taken over by the city. This highway passes through the upper end of the Crystal Creek reservoir and must be relocated.

The E. H. Honnen Construction Co. built the Crystal Creek dam and has the general contract for the Catamount Creek work. The American Bridge Co. furnished and placed the steel faces on both dams. Design and supervision of the improvement is being handled by city staff, E. L. Mosley, city manager, Frank O. Ray, city engineer, O. O. Phillips, designing engineer, and J. H. Sanford, resident engineer. The late D. C. Henny was consulted on various phases of the dam design.

Glass Block Windows Aid Functional Design of Factory

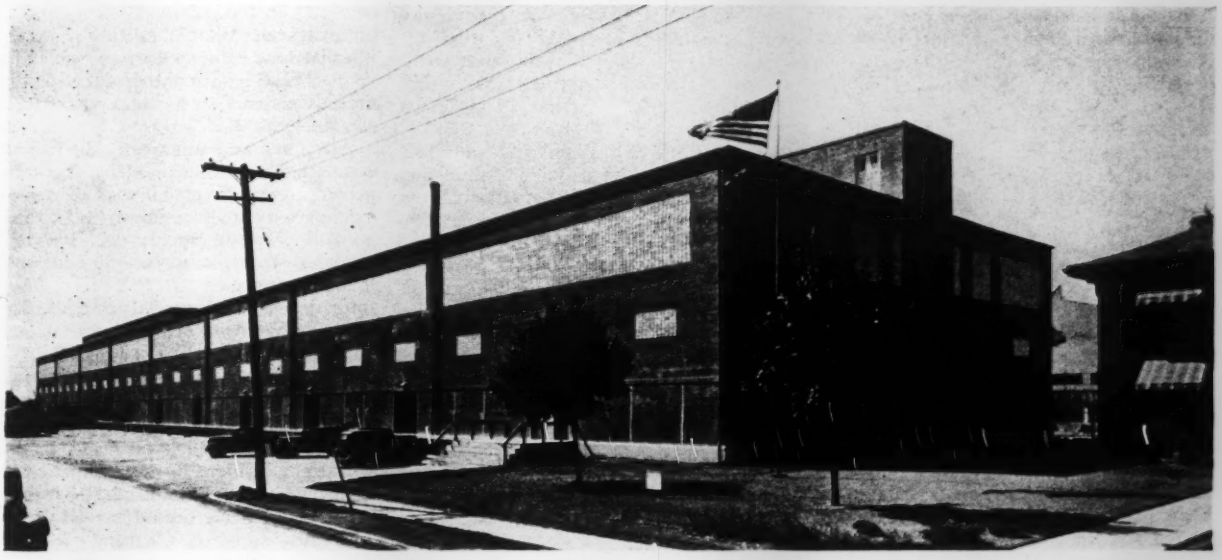
Panels of block set in brick walls vary in size according to manufacturing operations that they serve

A NEW DEVELOPMENT in functional design of industrial buildings is recorded in the new corrugated container factory and warehouse recently completed at the Gas City, Ind., plant of the Owens-Illinois Glass Co. This is the utilization of some 42,000 glass block arranged in panels to meet specific illumination requirements in each section of the structure which is 541 ft. long and 101 ft. wide. Thus there are long continuous panels of block to serve the manufacturing operations, small rectangles laid flat in the warehouse portion and tall slender rectangles in the paper supply room. Notwithstanding the fact that the owner is also the manufacturer of glass block, panels were restricted to the sizes justified by their location and function. An industrial building of unique appearance results, which the designers feel is also scientifically planned from an illumination standpoint.

The building is of steel frame and brick construction and is designed to accommodate both manufacturing and warehousing operations. It is two stories high and its floor plan may be understood by reference to Fig. 1. In the far (southwest) corner the monitor roof covers an area 72 ft. wide and 204 ft. long which accommodates roll paper storage, (Fig. 2). On a mezzanine which occupies the remaining 29-ft. width along the east wall, the production line begins, and this manufacturing floor widens out north of the roll storage room to the full width of the building. The entire first floor is given over to warehousing and bottle storage; it is served along the east wall by a truck loading dock and along the west wall by a railroad siding.

The framing of the building consists of rolled beams and columns except in the paper roll storage room which is spanned by welded roof trusses. Crane rails set 37 ft. above the floor in this area carry a 5-ton crane that transfers rolls from storage to the production line on the mezzanine. An interesting detail in the roll storage room is the

FIG. 1—ARRANGEMENT of glass block panels in east and north walls of new building. Long top panels serve manufacturing area on second floor while narrow panels admit light to warehousing area on first floor. High narrow panels in north wall admit light to stairways and elevators.



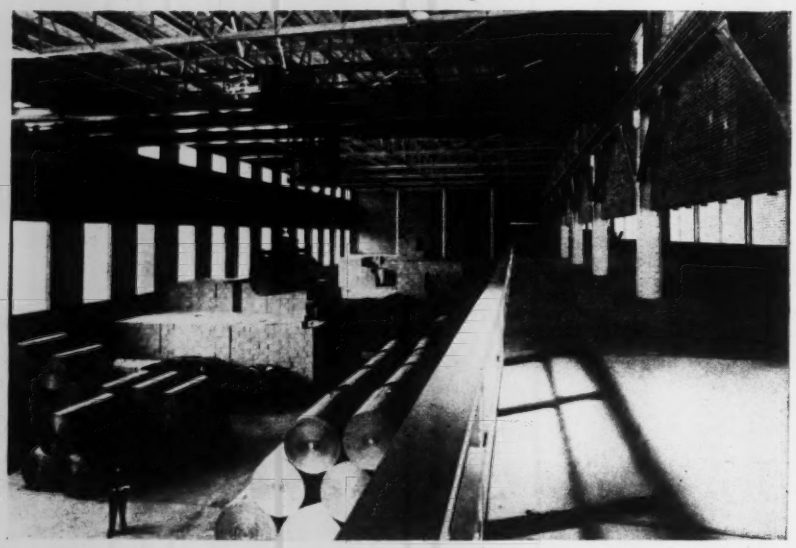


FIG. 2—Roll storage room lighted by large vertical panels in west wall and by smaller flat panels above crane rail in both east and west walls. Carton manufacturing machinery is to be installed along the mezzanine.

reinforcement of the walls by vertical steel beams anchored to the floor by two 1-in. dia. bolts and connected to a horizontal spandrel beam 12 ft. above the floor. These vertical beams resist the lateral thrust of paper rolls piled against the walls.

In Fig. 1 the eight horizontal panels that extend along the 541-ft. east wall are a distinguishing architectural feature but their presence is dictated by the need for abundant glareless daylight along the corrugating and box production line laid out along this wall on the second floor. These panels, 61 ft. 5 in. long and 8 ft. 7 in. high, are said to be the largest independent exterior sections to be constructed of glass block, not excepting the new Owens-Illinois office and laboratory building at Toledo (*ENR*, March 26, 1936).

The lower course of small horizontal panels, 7 ft. 6 in. by 3 ft. 4 in., is located at ceiling height of the bottle storage area on the first floor and is duplicated in the west wall of the building. In the north wall three high, narrow shafts of glass block ornament the entrance and furnish the necessary illumination for the stairwells and elevator lobbies.

In the roll storage room light enters from the west through 18 tall panels 12 ft. 10 in. by 3 ft. 6 in. set midway between the floor and the roof trusses. A second course of small horizontal panels admits more light from a higher point midway between the bottom chords of the roof trusses and the crane rail on the east and west walls of the roof monitor.

All glass block is laid in mortar somewhat richer than commonly used for brick work. Galvanized 2-in. reinforcing mesh is set in the mortar at every third course, and each of the glass block panels is calked top and sides with oakum and sealed inside and outside with a mastic joint.

A 4-in. layer of glass wool, serving both acoustical and insulating purposes, is placed beneath the roof deck in the manufacturing area and is supported by light-weight metal lath. The roof deck is of 2-in. yellow pine covered with asphalt roofing. Since no provision is made for wall ventilation a control system for circulation and air conditioning has been installed. The building was designed and built by the Austin Co., Cleveland, Ohio.

Grade Crossings Being Removed at Rapid Rate With Emergency Appropriations

ELIMINATION of railroad grade crossing hazards at an unprecedented rate has been made possible by the allocation last year of $200,000,000 of emergency relief funds for the purpose, according to the U. S. Bureau of Public Roads. With these funds alone, the Bureau reported recently, 2,097 existing grade crossings will be eliminated, 320 old grade-separating bridges will be rebuilt, and 1,037 crossings will be protected by the installation of safety gates, flashing signals, or other warning and safety devices. Of the 2,097 grade crossings to be eliminated, 1,579 will be wiped out by the construction of bridges to carry the highways under or over railroads; the remaining 518 will be avoided by relocation of the highways.

As evidence of the greater emphasis laid upon grade crossing improvements during the past year, the Bureau points to the fact that nine grade-separation structures in addition to those mentioned above will be built with emergency relief funds allocated for highway construction; and the 1,908 new and rebuilt structures planned in the single year are compared with the total of 728 structures planned to be built with other federal funds appropriated since 1933, and smaller programs of previous years.

A total of 281 structures and 136 highway relocations provided for in the last year's program were reported by the Bureau as completed on Oct. 1. On the same date installation of protective devices had been completed at 29 of the planned locations. The total cost of this completed work was reported to be $18,203,462.

Majority of work under contract

The greater part of the programmed work, involving an estimated cost of $112,929,765, was under contract on Oct. 1 and in various stages of construction. This work includes the building of new grade-separating structures at 830 crossings, the reconstruction of 162 inadequate existing structures, the avoidance of grade crossings by 246 highway relocations and the installation of protective devices at 33 crossings.

Of the remaining programmed projects, plans have been completed and approved by the federal bureau for 174 new and 36 reconstructed structures, 79 highway relocations, and 624 protective installations, estimated to cost $27,816,526. These additional projects will go under construction as soon as contracts can be let.

All states and practically all railroad companies have benefited by the safety promoting work made possible by the grade-crossing allocation of relief funds, according to the Bureau, which further explains that many of the improvements undertaken are in cities. Many, long desired and needed, it adds, have been impossible of realization previously for lack of money.

The Bureau reports that grade-crossing projects have furnished direct employment in recent months to an average of 40,000 men, and it estimates that indirect employment in the production and transportation of materials and equipment in the same period has been given to an additional 68,000 men.

Tunnels Reduce Slide Hazard on Cliffside Road

Sidehill cuts take to tunnel where scaling cliffs of Feather River canyon promise extra danger from slides

BY GOING UNDERGROUND at special danger points the engineers of the 70-mi. cliffside road in the Feather River canyon in California feel that a bad rockfall possibility has been safely avoided. The tunnels have cost not much if any more than bench cuts would have cost and their greater safety from slides is considered to be certain.

The canyon road which is scheduled to be completed in July, 1937, will open a new route from Oroville, county seat of Butte County, to Quincy, county seat of Plumas County. The location follows the Feather River and its north fork on a water grade for most of the distance. All but four miles of the seventy-mile length is in a narrow, tortuous river gorge, and here the location and construction are further complicated by the presence of the Western Pacific R.R. and several water power plants, existing and prospective. Several bridges over the Feather River and its tributaries are required; two of these cross the river and the railroad at the same point.

At Pulga a 350-ft. steel arch spans the railroad and the river with a grade 210 ft. above the stream bed. At Tobin the road crosses under the railroad at the end of a 300-ft. steel through-span over the river. Although these are exceptionally expensive points of the route, the entire line is costly; the average cost per mile in the canyon for providing a roadbed 20 to 24 ft. wide, including the bridges, is about $100,000 per mile.

In that part of the canyon shown in Fig. 1 the river has cut its way through solid granite formation, leaving rock walls, steep and bare, extending to great heights. As far as practicable the roadbed in this part of the canyon (about 2½ miles) has been provided by cutting a bench in the steep granite slope. The road grade is close to the river level but blocky granite lodging in the river is safe against erosion even in times of extreme high water, thus making it safe to use half-fill sections at many points.

Throughout the canyon it was necessary to put the entire location on the opposite side of the river from the railroad, except for a short section between Rock Creek and Storrie, where sufficient room was available between the railroad and the river to permit of safe clearance for construction operations. This crossing to the north side avoided difficulties in location and construction in passing the power plant at Storrie, as well as costly excavation.

Examination of the thin layers of granite that scale off in some parts of the canyon indicated that some of these were in such a state of equilibrium that disturbance by blasting or by removal of key blocks would loosen and release them. At one point there are indications that 75,000 to 100,000 cu.yd. of rock have come down from above in relatively recent times. Such a rock slide would have been highly destructive to bench cuts had they been in existence at that time. In fact, there was some question whether slides might occur which would block the river and raise its water level enough to require grade changes, if care were not used in cross-

FIG. 1—GRIZZLY DOME, forming one of the steepest portions of the canyon walls, is pierced by tunnels 2 and 3, the latter with four adits of full tunnel height.

FIG. 2—TYPICAL SLOPES in Feather River Canyon. Note the thin layers scaling off from the steep granite surface, constituting a menace to the road below.

ing the dangerous slopes. These considerations carried weight in favor of tunnels.

Granite promontories have a well-known tendency to scale off in curved layers as weathering occurs; this tendency introduces a serious future hazard in bench cuts through granite dome formation. A cut sufficient in width for a roadway subgrade in some parts of the canyon would have loosened an unknown number of scale layers. Hence, where the tendency to layer scaling is particularly marked tunnels were used instead of open cuts, as shown in Fig. 1.

Three tunnels have been built. The first, 261 ft. in length, was driven initially as an 8x14-ft. center heading and afterward was enlarged by ring drilling. The second tunnel, under a particularly steep rock known as Grizzly Dome, is 390 ft. long. The top heading method was used here and later the heading was enlarged to a 13x14-ft. section so that equipment could be moved through. The third tunnel, under another section of Grizzly Dome, traverses surface layers so weak structurally that it was decided to make the tunnel 1,172 ft. long and thus permit a location well below the surface in solid formation.

In this longest of the three tunnels there are four adits the full height of the tunnel and 30 to 40 ft. wide. During construction they shortened the muck haul and after the tunnel is opened to traffic they will admit light and aid ventilation. The cost of the tunnel excavation ranged up to $4.55 per cu.yd., but a considerable percentage of enlargement work has brought the average down to about $3.72.

Long Steel Arches Erected by Falsework Elevator

On new bridges in Stockholm half-arch spans were lifted at the crown while rotating about pins at abutments—Project includes a 668-ft. span hingeless arch and a 183-ft. all-welded two-hinged arch

TWO HIGHWAY BRIDGES having engineering interest because of the erection methods employed and because one utilizes hingeless steel arches of considerable size while the other includes an all-welded arch of 183-ft. span have been opened to traffic in Stockholm, Sweden. This city, as shown by Fig. 2, lies on several islands which dot the narrow arm of the Baltic Sea that extends inland over a hundred miles, widening out into Lake Malaren, one of the largest firths in Sweden. Formerly only one bridge connected directly the parts of the city lying north and south of this sea inlet; this was located at A, Fig. 2, the roadway crossing over a lock. The two new bridges, in line, and only 295 ft. apart, shown at B and C, Fig. 2, provide a second and far more ample connection; they have, therefore, major traffic importance as well as technical interest.

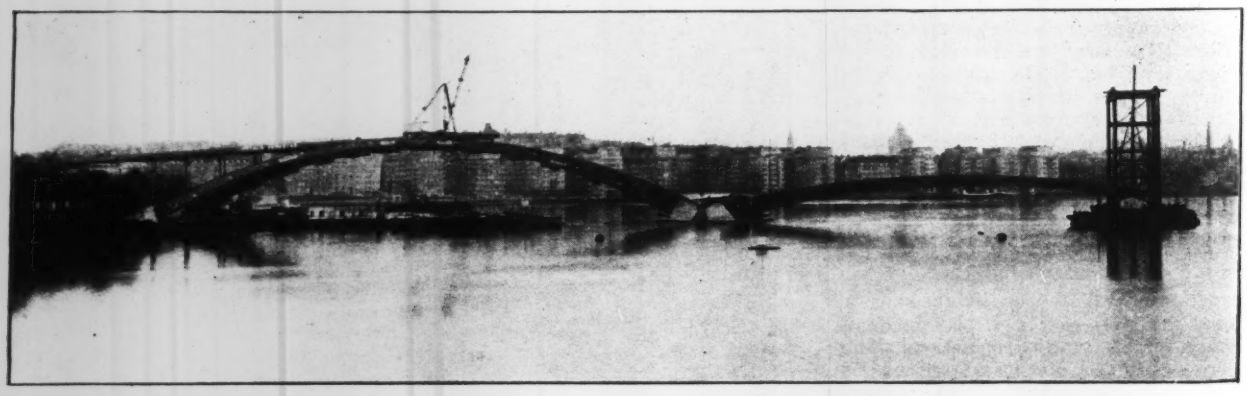
The two bridges are named the West Bridge and the Palsund Bridge, the latter being the smaller and the one with the welded arch span. In general appearance, both bridges are similar, having steel arch main spans and steel viaduct approaches. The same loading and design conditions and the same erection methods were used for both and so only one, the larger West Bridge with its hingeless arches, will be described at length, with some account of the welded arch span of the Palsund Bridge.

West Bridge structure

As is shown in Fig. 5, the West Bridge has two arch spans, one 668 ft. and the other 551 ft., making, with the approach viaducts, a steel structure 1,973 ft. long. This structure carries a deck 78 ft. wide which provides for two street car tracks, four lines of vehicle traffic and two sidewalks. The deck is supported, both on the approaches and over the arches, by pipe columns manufactured from curved plates by welding. The plates are ½ to 1 in. thick and the column diameters vary from 24 to 28 in. To insure against interior corrosion, the ends of the columns are hermetically sealed by the bearing shoes. The shoes at the base of the columns are ball and socket type, to separate effectively the superstructure and the arch. Except for the floorbeams, all of the superstructure steel is arc welded. This includes ten lines of plate-girder stringers, transverse load-distributing joists between the stringers at the center of each 42-ft. panel and the lateral bracing. Stringer-floorbeam field connections are also made by welding, to develop continuity.

The arch ribs and floorbeams are made of copper-manganese steel with

FIG. 1—ERECTING SECOND ARCH of West Bridge, Stockholm, Sweden, using a falsework elevator at the crown to lift a half span at a time. The arches, of fixed type, have spans of 668 and 551 ft.



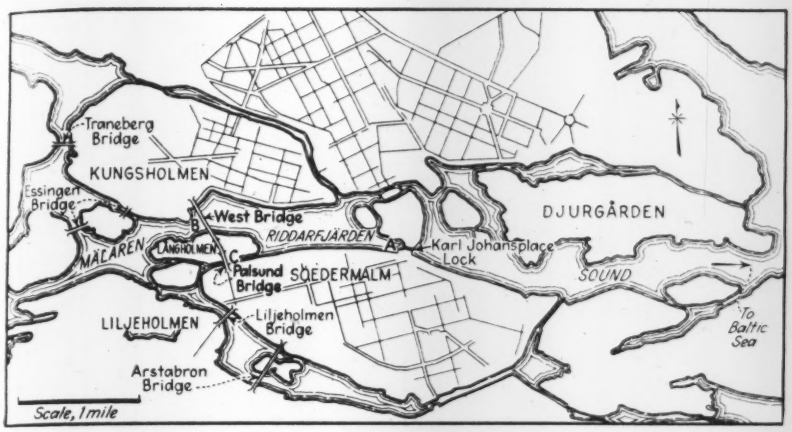


FIG. 2—LOCATION of West and Palsund bridges in Stockholm. Previously the only north-south crossing was at point marked A. The Traneberg Bridge (upper left) contains the second longest concrete arch in the world, 594 ft. (ENR, June 7, 1934, p. 727)

FIG. 3—ERECTION YOKE that carried the abutment end of the arch as it rotated about a temporary pin

a minimum ultimate strength of 73,960 lb. per sq.in., a 51,200 lb. per sq.in. yield point, and 20 per cent minimum elongation in 8 in. Medium carbon steel is used elsewhere, the total being 3,200 tons compared with 3,700 tons of copper-manganese steel.

The hingeless steel arch ribs, two for each span, are spaced 59 ft. apart transversely and are connected by struts and a system of k-bracing. The rib depths at the crown are 7.5 and 9.2 ft. for the short and long spans, respectively; comparable depths at the abutments are 15 and 17 ft. Each rib is a box with webs spaced 34 in. apart. The longer arch span provides a 71-ft. shipping clearance for a width of 164 ft.

The loading specifications used provided for an equivalent load corresponding to an unlimited number of 15-ton trucks on each of the four roadway lanes at the same time that each of the rail tracks is loaded by an electric train consisting of one 44-ton motor car and four 28-ton trailers. In addition it is provided that the bridge shall sustain electric trains consisting of a 68-ton motor car and three 40-ton trailers when no other live load is on the bridge.

Impact is provided for by using the formula $I = 680/(20 + l)$ where I is the per cent load to be added to the live load and l is the loading length in meters that produces the maximum live load stress in the member if but two loading lanes are considered. When more than two lanes are loaded, the effect of impact is omitted.

The sidewalks are designed for a uniform load of 82 lb. per sq. ft. or a concentrated load of 5½ tons acting at any point, as might result from a truck mounting the curb. For the concentrated load it was specified that the total unit stress due to dead and live loads should not exceed the yield point of the material.

It is in the fieldwork that the new bridge is particularly interesting. Foundation work was comparatively simple since maximum rock depth was only 40 ft. Separate concrete piers and abutments are used for each rib. They are faced with granite at water level.

Cofferdam construction presented one uncommon procedure. At the abutments the bedrock has a down slope

FIG. 4—VIADUCT AND ARCH SUPERSTRUCTURES are identical consisting of riveted floorbeams and welded stringers, bracing and pipe columns

FIG. 5—PIPE COLUMNS supporting the 78-ft. deck give the new West Bridge in Stockholm a unique appearance

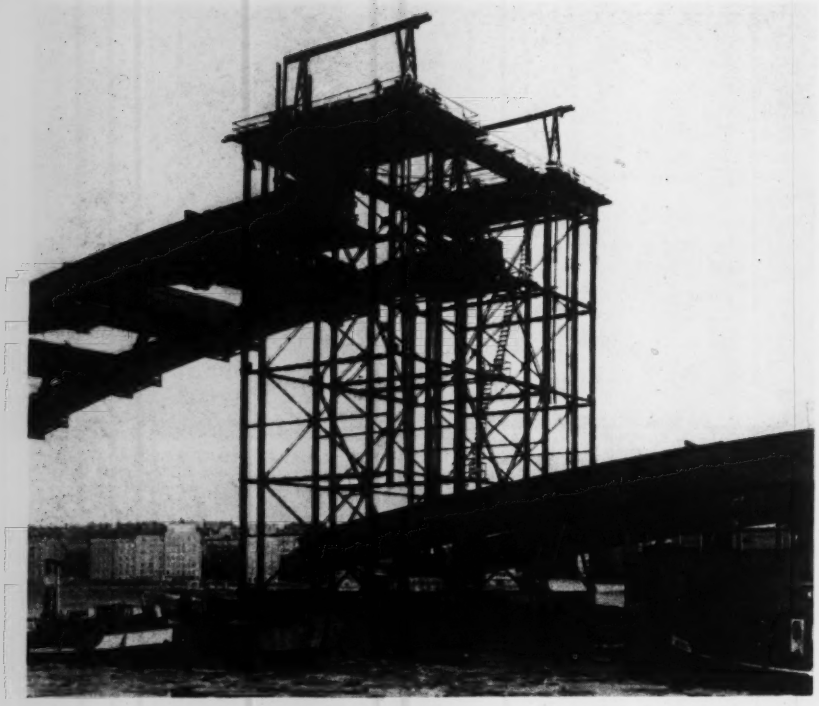


FIG. 6—FALSEWORK ELEVATOR which lifted ends of half arches to a connection at the crown. The left half is in final position while the right half rests on the floating drydock until the lifting bars can be attached

toward the channel and an irregular surface. Cofferdams with edges corresponding to this surface therefore were built suspended inside of timber falsework that was erected over the foundation sites; as they were completed the cofferdams were lowered into place and a tremie concrete seal 6 ft. thick deposited. The cofferdams were then pumped out and the foundations completed in the dry.

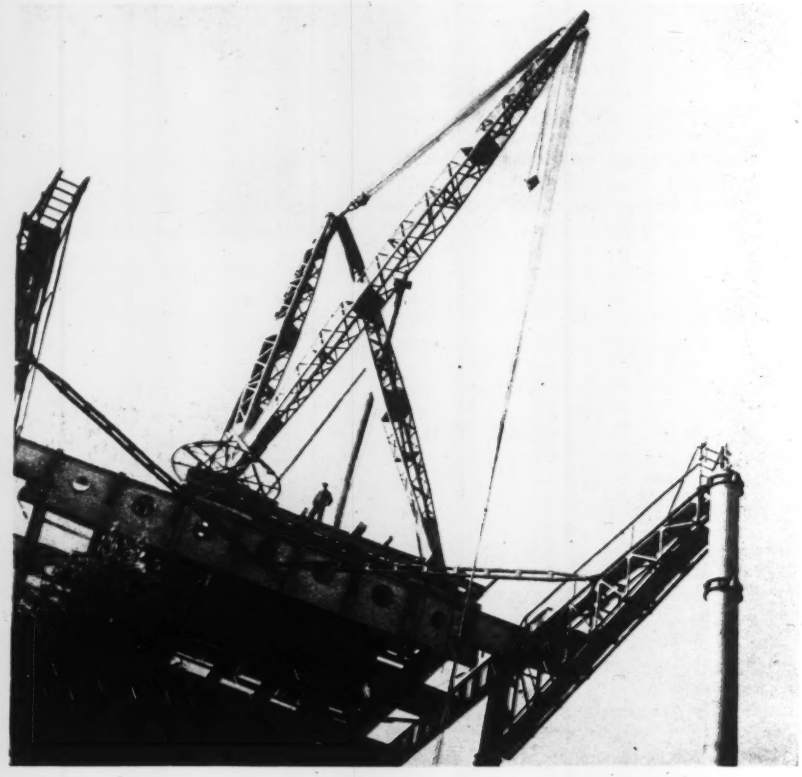
Arch rib sections received from the fabricator in Germany were assembled into half-span lengths at a yard about a mile from the bridge location and then moved to the side on a floating drydock. Here they were transferred to falsework supports at the abutments and under the center of the arch spans. After two arch ribs corresponding to a half-span were connected by the transverse bracing, the unit was ready for raising.

On a steel foundation under the center of the span a steel tower was erected. Hydraulic jacks were placed on top of the tower and then through a chain attachment the half span was raised at the crown while turning about temporary pins at the abutment in such a manner that the ribs came to bearing on the steel shoes, one at the top flange and one at the bottom flange of each arch rib. The temporary pins at the abutments were supported on steel yokes placed around the abutment monoliths. (Fig. 3).

At the crown the half span was supported near the top of the steel staging until the other half of the span could be raised. The two halves came together on a temporary crown hinge. Horizontal hydraulic jacks were then installed to induce an initial bending moment into the ribs corresponding to that which would be caused by the loads on the completed bridge. As a final operation the crown joint was spliced, transforming the structure into a hingeless arch.

The erection of the arch and viaduct superstructures was carried out a panel at a time by means of a deck traveler assisted by a unique movable falsework. As shown in Fig. 7, this falsework consists of two cantilever cradles located beneath the facia stringers and supported by clamps on the columns of the last bent erected. With the cradles swung into place, the traveler raised the columns of the next bent which were then clamped to the ends of the cradle. Next the facia stringers were laid on the cradle and the floorbeam raised and connected to the columns and to the facia stringers. The panel of steel was completed by filling in the remaining stringers and the cross joists. The traveler then picked up the falsework cradles and moved ahead for the next panel.

FIG. 7 — ERECTION EQUIPMENT consisted of a deck traveler and cantilever falsework brackets that steadied and supported the columns, floorbeam and fascia stringers until they could be joined together



Palsund Bridge

The 183-ft. arch of the Palsund bridge is entirely arc welded including the ribs. Floorbeams, stringers, pipe columns and bracing were shop fabricated but the ribs were built up from

FIG. 8—PALSUND ARCH SPAN of 183-ft. is among the notable all-welded bridges of the world

plates in the field. Each rib consists of two 49 x ⅝-in. web plates and two 51 x 1½ in. flange plates. The ribs were assembled in half-span lengths and erected by the same procedure as used on the West Bridge except that no temporary abutment pins were required, this being a two-hinged arch.

Floorbeams, 64 ft. long, are made up of a web plate decreasing in depth from 81 in. at the center to 37 in. at the ends, and two 2⅜ in. flange plates 16 in. wide in the center and 12 in. wide at the ends. Web stiffeners are provided only at the stringer connection joints which are 11½ ft. apart; these stiffeners consist of the stringer itself and a seat bracket that extends to the bottom flange. Copper-manganese steel is used for the floorbeams and carbon steel for all other members, including the arch rib. The total weight of the steel superstructure is about 1,100 tons. Studies indicated that this represented a saving of about 200 tons over a comparable riveted design.

Administration

The new bridges have been built by the Stockholm Harbour Board. All designing work and the technical control of construction were executed by the bridge designing bureau of the Board under the management of Major Ernst Nilsson, chief designer.

Obstacles to Municipal Career Service

MANY OBSTACLES now stand in the way of local governments getting the best talent in employees and administrators, according to a report recently made by the committee on local government career service of the International City Manager's Association. The drawbacks, which are widespread though not universal in the city halls, are listed as:

(1) Local residence restrictions. When municipal jobs are given to home-town boys only, men with exceptional qualifications who get their start and gain good experience in their own home-towns find it impossible to continue governmental careers in other cities and must look to private employment for further advancement.

(2) Restricting what careers there are to single departments and bureaus. Careers even in a single city are rarely treated on a city-wide basis, and career opportunities are most often segregated by departments and bureaus, which makes nearly impossible the development of a qualified group of administrators.

(3) Low standards of educational and age qualifications. For fear of keeping out of the public service a genius with great native ability but slight schooling, easy examinations are the rule. When the New York City Civil Service Commission attempted to require a high school education of candidates for the position of market supervisor, pressure from employee and civic groups compelled the commission to abandon the rule. Municipal employment has been open to all ages, thereby giving persons who have failed in private employment, but who have knowledge gained by experience, an undeserved advantage in competition with youngsters of ability but without experience. The result has been to endow private employers with young men of ability and to relieve private employers of their deadwood.

(4) The "charity concept" of the public payroll, which in the code of the spoilsman means that local jobs should go to his henchmen; in the philosophy of the non-partisan, that the public payroll should be used to provide work for the local unemployed.

(5) Niggardly salary standards for administrative officials, in contrast to salaries offered in private industry. This often requires a brainy man to make too great a monetary sacrifice if he stays in the public service.

(6) Lack of organized personnel administration, true of many cities, both large and small. Placing a city under civil service, it should be understood, does not automatically provide intelligent and constructive consideration of the personnel problems.

(7) Failure to give more than passing consideration to important personnel problems, such as discipline of employees; employee-administrator cooperation through employee organizations; physical, social and other conditions of employment; and in-service training opportunities.

(8) Low prestige of the municipal service, as compared not only with private employment but also with the state and federal services.

(9) Little thought and research given to career service at the local government level. Although municipal functions are of vital importance to the welfare of the American people, the federal service has captured popular imagination because federal activities are more dramatic, more publicized, and less familiar.

The public, says the Committee, should be educated not only by national groups seeking better government personnel in general, but by local civic groups. Laymen and administrators alike must be led to recognize the need for a comprehensive system of hiring public employees that includes much more than mere civil service, with its original selection and job classification schemes. The public also must realize that in hiring and promoting employees the city is purchasing services for which it should expect full value and is not distributing relief. Professional organizations of public officials—finance officers, public works engineers, welfare administrators—need to become more active in raising professional standards, in providing training opportunities, and in making department heads and general administrators aware of their duty to help establish a career service. They need to work for the abolition of local residence requirements. Apprenticeship opportunities in government need to be opened, giving young men and women a chance to train for public positions.

Structural Alloys and River Control Discussed at Pittsburgh—II

Fall meeting of American Society of Civil Engineers covers timely subjects in a group of symposiums

IN A PROGRAM of unusual breadth, the fall meeting of the American Society of Civil Engineers at Pittsburgh, Oct. 13-16, produced a volume of material that could not be completely covered in last week's report which included the flood control, river pollution, surveying and power generation papers. In this second half of the report the important symposium on structural alloys and the highway design and financing papers form the subject matter.

High strength metals

The symposium entitled "Structural Applications of Steel and Lightweight Alloys" which occupied the sessions of two complete days and included a dozen papers was planned to emphasize to structural engineers a development (now confined largely to automobiles, airplanes, and railroad rolling stock) that is converging on their field of operations. As expressed by Jonathan Jones (McClintic-Marshall Corp.), chairman of the sponsoring committee, "It is incumbent upon structural men to inquire what new economies, what new possibilities may be anticipated in the structural field from the newer knowledge and the newer structural materials." The papers, falling into three groups, (1) modern stress theories and research, (2) metallurgical and manufacturings aspects, and (3) structural applications, will be available in full in the October *Proceedings* of the Am.Soc. C.E. Only enough of their content can be presented here to indicate their importance and scope.

More refined design

High-strength materials are high-cost materials whose justification rests very heavily on efficient design, the attainment of which will require several changes in engineering attitude. A. V. Karpov (Aluminum Company of America) delineated some of these necessary changes in a paper which suggested that many refinements now confined to aeronautical or automotive engineering must become commonplace in the structural field if higher-strength materials are to be used. For example, stress concentrations, fatigue and creep phenomena become important. Idealized designs, assuming materials of perfect elastic properties and joints of theoretically perfect efficiency, can no longer be expediently used as in the past. A few of the design considerations that high strength materials foster were cited by Mr. Karpov: (1) Several moduli of elasticity are available, 29,000,000 for low alloy steel, 25,000,000 for high alloy and stainless steels, 10,300,000 for aluminum, and 6,500,000 for magnesium alloys; (2) stress strain relationships differ, Hooke's law being questionably applicable to high-strength steels and lightweight alloys having no sharply defined yield point; (3) boundary conditions, such as are caused by corrosion and surface irregularities, become highly important when the thin members permitted by high strength materials are used; (4) these same boundary conditions accentuate the possibility of fatigue failure, so that fatigue properties assume importance; (5) stability becomes important for thinner members and is exceedingly difficult to design for mathematically; (6) factors of safety may be reduced by more refined design and in line with desired ceonomy, but attention must be given to the "ultimate" factor of safety after plastic flow, stress concentrations and corrosion have taken their toll; present practice guesses the "initial" factor of safety high enough to overcome these weakening influences.

In discussion, Jonathan Jones pointed out how one of these new considerations —fatigue—is already being recognized in bridge welding specifications in which unit stress formulas are based on repeated load experiments and include both maximum and minimum load values. Shortridge Hardesty, consulting engineer, New York, stated that his office has given increased attention to the effects of pulsating stresses in the past few years because of greater appreciation of their importance when considering high strength materials.

As aids to more refined designs, model studies have proved distinctly useful. R. L. Templin (Aluminum Co. of America), in his paper on "Tests of Engineering Structures and Their Models," explained the purposes and types of tests that may be made. Among the more novel studies that he described was one using a model larger than the prototype. This over-size model reproduced a filleted re-entrant 90 deg. corner. Its use enabled the stress distribution pattern to be obtained with conventional and available strain measuring equipment and, by measuring strains on rosettes, both the direction and magnitude of the stresses at points away from the edge of the specimen were secured. In commenting upon model testing technique, Mr. Templin made an arresting comparison between a strain gage and a cornet in which he noted that anybody can pucker his lips and make a noise on a cornet but only an expert can produce real music; likewise, only experts get useful results with strain gages.

Photo-elastic determination of stress was the subject of a paper by J. H. A. Brahtz (U. S. Bureau of Reclamation) which was presented in the author's absence by Dean Hollister of Cornell. Although a descriptive paper, largely given to inquiring into the possibilities of the photo-elastic method, two special types of apparatus were described. One was the membrane profilometer by which the sum of the principal stresses may be obtained; ordinary photo-elastic methods give the difference of the stresses, and with both the sum and difference available the stresses may be calculated. In the profilometer a rubber membrane is stretched over a frame shaped like the model and built with its vertical ordinates proportional to the sum of the principal stresses of the boundaries which are determined from isochromatic photographs. The other ordinates of the warped surface of the membrane can then be measured with a depth gage.

The second piece of equipment is an interferometer which measures individual principal stresses in a transparent model directly, thus eliminating the necessity for finding the sum of the stresses. Essentially the method consists of splitting a pencil of light, one part of which traverses a loaded model at a point vibrating in the plane of one

of the principal stresses, while the other part goes around the model. The two pencils of light are brought together again and interference fringes result. The stress at the point in the model will be proportional to the relative displacement of these fringes as the load is applied. Next the ray is made to vibrate in the plane of the other principal stress, and the measurements are repeated.

Discussion contributed by E. K. Timby (Princeton University) described most of the important instances in which models have aided design, and Rudolf Bernhard (Baldwin-Southwark Corp.) described a machine for determining periods of vibration of structures from energy-frequency curves. The machine has been used in Europe for bridge inspection.

Metallurgy and manufacture

What are these new high-strength metals? Three papers described them as (1) low alloy structural steels, (2) stainless or chrome steels, (3) aluminum and magnesium alloys. The situation with respect to low alloy steels was treated in a paper by E. C. Bain and F. T. Llewellyn (U. S. Steel Corp.). Development of alloying combinations is a most complex operation since each alloy often acts differently in the presence of one of the others. Sometimes the action is desirable, sometimes detrimental. A fundamental is to adjust the alloying elements so that the gains in desirable properties exceed the losses. The new steels, in comparison with mild carbon steel, are characterized by a lower carbon content, a higher yield point, but with very little reduction in ductility, a rather high ratio of yield point to ultimate strength and high corrosion resistance. Manganese, nickel, chromium and silicon are effective strengtheners while copper, phosphorous, molybdenum and vanadium are useful auxiliary elements. Copper, nickel, phosphorous and chromium enhance corrosion resistance. Manufacturing operations are not radically different from ordinary steel practice.

In discussion the relatively small spread between yield point and ultimate strength of these steels was the principal item considered. Mr. Hardesty pointed out how these yield points were from 80 to 90 per cent of the ultimate as compared with A.R.E.A. bridge steel requirements of 70 per cent. Otis E. Hovey held that this 70 per cent figure was a relic of heat-treated steel practice of 20 years ago and needed restudy in the light of these new steels. Mr. Bain referred to the good ductility in spite of high yield point, but L. S. Moissieff agreed with Mr. Hardesty that engineers still feel that a rather wide range is desirable so that flow and adjustment can take place safely beyond the yield point. This feeling, he pointed out, is not substantiated by absolute knowledge, but neither is it disproved, for the knowledge is lacking. Mr. Moissieff also called attention to the advantage of rivet yield in ironing out "hard spots" in joints whereas with welded joints this advantage disappears; perhaps the steel itself and the weld metal will have to provide the yield. Tests are needed to show the designing engineer the exact results of this high yield point.

The remarkable twenty year growth of stainless steels, a large group with a base of about 14 per cent chromium, was outlined by M. J. R. Morris (Republican Steel Corp.); one ton in every 15 tons of steel made in 1929 was stainless. Although a chromium steel was first used in the arches of the Eads Bridge at St. Louis in the 80's, the new stainless steels are different in that nickel is usually added to the chromium to improve its physical properties while molybdenum and silicon are present to increase surface stability. Made in an electric furnace and requiring other special manufacturing operations, stainless steels are expensive, about 30 cents per pound as against 1 cent for mild carbon steel. They have consequently seen no service in structures. On the other hand a number of civil engineering installations where economy was possible in spite of high cost have benefitted from their use: expansion joints in TVA dams; separation sheets between old and new portions of the Assuan Dam in Egypt (2500 tons); concrete reinforcing rods at the Hawks Nest, W. Va., power plant; sluice gates on the Arapuni power project in New Zealand; wire for the auxiliary counterweight cables on the Cape Cod lift bridge; pipe lining in the Milwaukee sewage plant; intake screens in water supply plants; lining for an intake shaft 10 ft. high and 39 ft. in diameter on a Chicago waterworks crib; tie rods 40 ft. long and 4 in. in diameter across the dome of St. Paul's Cathedral in London; and trash racks at the Holtwood power plant on the Susquehanna River. A special stainless product (monel metal) covers the roofs of the Pennsylvania station and the public library in New York.

The light-weight structural alloys of aluminum and magnesium were described in a paper under the joint authorship of Zay Jeffries and C. F. Nagel (Aluminum Co. of America) and R. T. Wood (Magnesium Corp.). The heat-treated structural alloys of aluminum (17 ST and 27 ST) are widely familiar, the former being duralumin of airplane fame, the latter the alloy used most commonly for high-strength structural purposes. In the manufacture of these alloys, heat treatment followed by quenching causes a precipitation of certain constituents, the effect of which is observable by an increase in strength, hardness and workability without a lowering of elongation values. Strengths comparable to alloy steels are available. The modulus of elasticity, on the other hand, is only one-third that of steel. Plates up to 120 in. wide and rolled or extruded shapes up to 12 in. size can be obtained. Welding or flame cutting is not possible on the heat-treated alloys. Steel rivets usually are used for joints.

Magnesium base alloys have not as yet been used structurally although plates and shapes are available. The modulus of elasticity as well as the specific gravity of these alloys is about two-thirds that of aluminum. The aluminum and magnesium paper is very complete in defining the metallurgical and physical properties of the materials.

What about corrosion?

A common characteristic of most of these new metals is a relatively high resistance to corrosion. The whole corrosion question—the mechanism of its action and the relative resistance of various metals—was presented by James Aston, Pittsburgh. Common structural steel is rendered resistant to atmospheric though not submersion corrosion by a small copper addition. Phosphorous acts similarly but also engenders brittleness. Sulphur is distinctly harmful. Nickel is useful but costly. Manganese and silicon confer no corrosion resistant benefits. In the new low alloy group chromium or nickel must be high to make the steel corrosion resistant; thus the steels are expensive if only corrosion resistance is sought. Wrought iron is conspicuously corrosion resistant. Mr. Aston concludes that while some parts of structures can stand the extra cost of corrosion resistant metals, the dominant material will continue to be plain carbon steel, so that paint remains the best universal defense against corrosion.

Structural applications

Four papers were addressed to the subject of structural application—special steels by V. D. Beard, American Bridge Co.; stainless steels by E. J. W. Ragsdale, Edward G. Budd Mfg. Co.; aluminum alloys by E. C. Hartmann, Aluminum Co. of America; and magnesium alloys by A. W. Winston, Dow Chemical Co.

Each of the papers presented a large amount of pertinent data on design and fabricating practices. Structural applications of magnesium alloys are as yet absent in the civil engineering field. Aluminum alloys, on the other hand, have been used somewhat more widely, for traveling cranes, for bulkheads on the Gallipolis dam in the Ohio River, for the Smithfield Street bridge floor in Pittsburgh, for a removable railing on the Rio Grande Bridge at Laredo, Texas, and for the Stratford Ave. bridge floor at Bridgeport, Conn. Stain-

less steels, as noted above in Mr. Morris' paper, have found civil engineering uses but few structural applications. An exception might be noted in the case of the shot-welded stainless steel model of the Golden Gate Bridge towers. In such service, Prof. Timby of Princeton remarked in discussion, stainless steel offers the structural engineer a very useful tool since models may be built reproducing exactly every detail of the prototype.

Where special steels are used

Mr. Beard's paper brought together for the first time an immense amount of data on the types of special steels used in a large number of well known bridges and buildings. It is to be noted that these are not the new low alloy steels. Most of this steel is structural silicon, but nickel steel and heat-treated eyebars also account for substantial tonnages. The most recent nickel steel structure is the cantilever span in the East Bay crossing of the San Francisco-Oakland Bridge where a total of 3400 tons is required. Manganese steel is represented in only one bridge, the Bayonne arch. Buildings seldom require alloy steels although an exception is the Cleveland Terminal tower with 25 per cent of its 17,000 tons of silicon steel. Two recent examples cited were the Philadelphia post office where 252 rolled silicon beams 36 in. deep and totaling 1740 tons are used as a substitute for cover-plated carbon steel beams; and the Washington, D. C., post office where 2975 tons of silicon steel went into plate girders, column slabs, floorbeams and some 60 per cent of the columns and trusses.

Other recent uses for silicon steel reported by Mr. Beard include erection derricks for the San Francisco-Oakland Bridge and long span traveling cranes in a steel mill. Manganese steel fitting-up bolts have become common, and necessary, for "making joints" in structures using the silicon and nickel steels. Copper-bearing steel, with a maximum of 0.20 per cent copper, is becoming more popular, all of the 144,000 tons of steel in the San Francisco-Oakland Bridge (both carbon and special) being of this type.

Many of the considerations which governed the adoption or rejection of high-strength steels in the past will also be effective in determining the use of newer high-strength metals in the future. The evolution of such well-known structural steels as nickel and silicon is consequently of fundamental importance. Out of his wide and long experience as a participant in this evolution, Leon S. Moissieff, consulting engineer, New York, prepared and presented one of the most important papers of the symposium. It will be abstracted in more detail in a later issue but the thread of its argument belongs properly to this report.

Higher-strength steels grew out of structural requirements, first as a result of heavy locomotives requiring stronger bridges, later as a result of automotive transportation which made long span bridges not only desirable but financially possible. Nickel steel was first used in 1905 for eyebars in the Queensboro Bridge in New York, to provide a manageable size section. It was expensive but the only dependable product available. Silicon steel was introduced on the Metropolis Bridge over the Ohio River in 1915 for reasons of economy. Its cost is only 10 to 15 per cent more than carbon steel, and as a result some 350,000 tons of it have been used in bridges since. Nickel steel has also exhibited growth although, comparatively, it has been small.

Out of experience with these two steels, engineers have catalogued a number of advantages and limitations. The higher yield point permits higher stresses for static loads; for frequently reversed stresses, however, the high yield point is secondary to the ultimate strength. Members made of high-strength steel are smaller than carbon steel members and therefore exhibit greater deformations, making the structure as a whole less stiff. Under vibratory loads, structures of high-strength steel vibrate more because of the smaller moment of inertia of the members. Stronger steels are not proportionately more stable against buckling than common carbon steel. More care is required in fabricating expensive high-strength steels, and their higher elastic limit makes the work more difficult and expensive. Also, the higher elastic limit causes greater concentration of stresses at rivets, and less uniform stress distribution over the joint. At abrupt changes in section, this higher elastic limit is also a disadvantage from the stress concentration standpoint. High-strength steels, concludes Mr. Moissieff, are not therefore an answer to every requirement. Their limitations are quite as real as their advantages, and these limitations need to be fully known and clearly recognized before the steels can be used safely and economically.

Modern highways

The engineering and financing problems of streets and roads occupied the attention of both the city planning and the highway divisions. Eleven papers were presented among the most important of which was one on modern highway design by W. V. Buck, U. S. Bureau of Public Roads, Columbus, Ohio.

In a precise and pointed analysis of the responsibilities of present day highway engineers in the matter of road design, Mr. Buck urged recognition of the fundamental that highway traffic is individualistic in the matter of speed and recklessness and, while this is to be deplored, it is nevertheless necessary for the highway designer to recognize and accept it by providing a reasonable margin of safety in his designs. Statistics were cited indicating that 30 per cent of all accidents may be traced to some fault in road location or design. Curves, said Mr. Buck, should be made safe to travel and not considered merely as connections between tangents. He recommended that we stop figuring how little super-elevation can be used and "tip them up." He also urged the necessity of spirals, to aid the driver in staying on his side of the road.

Grades are not important except where heavy vehicles predominate. In such cases it would be good practice and often more economical to provide an extra lane for slow trucks instead of reducing the grades.

In the matter of sight distance a minimum of 1000 ft. should be used where opposing traffic is not separated. On three-lane roads a minimum sight distance of 1500 ft. is absolutely necessary for safety. Lanes of opposing traffic should when possible be separated, and a 4 ft. width of separation is the minimum. However, such a minimum does not afford safety for cross traffic which needs a "breathing space" in the center of wide roads. At intersections the separation should be at least 30 ft. wide. Roads planned for future widening should be developed on the outside, with the extra width placed in the center strip. By this procedure drainage structures, back slopes, etc., will not be lost by future widening. Although 10 ft. is now the agreed minimum width for lanes, 11 ft. would be better since drivers will not stay near edges at high speeds. Nearly all rights-of-way are too narrow. Wider shoulders for stopped vehicles are desirable. Also, slopes as flat as 5:1 on fills and 3:1 in cuts would be useful in providing added sight distance and reducing maintenance costs from erosion. It is also time to think of sidewalks for pedestrians and turnouts for buses, all of which require a wider right-of-way.

Agreeing with a remark of Mr. Buck's that in grade crossing elimination the highway is sometimes slighted in favor of the railroad, H. W. Griffin of the New Jersey highway department said that many eliminations create highway hazards almost as bad as those eliminated. He also stated that sentiment in favor of bypass routes is slowly developing. As to location details he held that it is not necessary to avoid overlap of vertical and horizontal curves. He questioned the need for superelevation in most instances. The 3-lane road, he said, is not so dangerous as the 4-lane undivided road which is much too dangerous for fast traffic in the country.

Other highway papers covered soil mechanics by K. B. Woods, Ohio highway department; pavement surfaces by H. F. Clemmer, department of high-

ways; District of Columbia; bridges by Walter G. Smith, Ohio highway department; concrete durability by H. S. Mattimore, Pennsylvania highway department; and asphalt pavement weathering by Malcolm S. Douglas, Case School of Applied Science.

Traffic and financing

A half dozen papers were directed to the economic problems of highways with particular reference to the Pittsburgh area. Based on studies of traffic in Pittsburgh, a paper by Lewis W. McIntyre, president of the Institute of Traffic Engineers, provided some definite figures on such interference factors as cross streets, parking, etc. With interference eliminated, it is estimated that the capacity of a single lane of street in a congested city district is from 2000 to 2500 passenger automobiles per hour. Interference by cross traffic reduces this capacity 50 per cent. The stopping of a lane of traffic when stops come close together reduces the capacity 35 to 50 per cent. Left-turning vehicles slow up traffic to an amount equal to four vehicles going straight through, while left-turning street cars are equivalent to 21 vehicles going straight through. Curb parking reduces the capacity 50 per cent. Vehicles weaving from lane to lane cause changes in effective headway equivalent to that caused by six vehicles going straight through.

The studies showed that empty taxicabs account for 20 per cent of the motor traffic, that trucks reduce roadway capacity 25 to 40 per cent as compared to automobiles; that 23 per cent of the pedestrians crossing streets interfere with vehicles and that 56 per cent of all pedestrians cross on the red light.

A significant fact reported is that up to 50 per cent of the traffic in congested districts is non-business-producing, supporting the contention that bypasses are badly needed as benefits both to the motorist and to the business owner.

Edward L. Schmidt, planning engineer, Allegheny County, set forth some of the essential data of road and street proportioning as deduced from experience in the Pittsburgh district. His figure for working capacity of a single lane, 300 vehicles per hr., or 5,000 per day, was stated to check with the prior findings of S. Johannessen and others. Three-lane construction is not generally desirable except as a transition device to four-lane. In divided four-lane construction the center strip should preferably be 40 ft. wide. Some of the author's figures on economic location data include the following: Value of distance saving, 1c. per 1,000 ft. per vehicle, which means a capitalized value of $57,500 per 1,000 ft. per 1,000 vehicles daily; saving of traffic delay, 1.25c. per vehicle minute, or capitalized value of $76,000 per minute's delay for all vehicles in a traffic of 1,000 vehicles daily; total accident hazard, 1c. per vehicle mile.

U. N. Arthur, former chief engineer of the department of city planning, Pittsburgh, described how the several wide boulevards that Pittsburgh has built have not raised adjacent property values and in some cases have depressed them. On the other hand, property a block or two away has received some benefit from increased valuation. The principal benefit has been not to the district traversed by the highway but to the community as a whole.

The rugged topography of Pittsburgh makes it difficult to widen existing streets without destroying land values which is in contrast to the situation existing in such cities as Chicago and St. Louis.

More extensive data on this question of road cost and real estate values were contributed by Joseph White of the Allegheny county department of public works. Although the increased valuation of real estate does not by any means take care of the cost of highway improvements, there is a relation between the two, if it is recognized that there is a lag of about ten years between cause and effect. The study which Mr. White reported showed that real estate valuation has not increased enough in 20 years to defray road costs which are very high because of local topography; that the rate of increase in real estate valuation does not correspond to the rate of increase of population, either in the county as a whole or in separate areas; and that in the outlying rural areas the effect of roads on real estate valuations depends on maintaining a proper balance between local roads and through roads connecting with the Pittsburgh business district.

Methods of relieving Pittsburgh's traffic congestion, outlined and illustrated with moving picture films by D. M. McNeil, acting traffic engineer, Pittsburgh, include: Grade separations, progressive signal systems, pedestrian regulation, pedestrian underpasses (mostly failures), elimination of turning movements, rotary circles (must be of 250-ft. diameter or over), parking restriction and enforcement, off-street loading, increase in parking lots and garages, increased curb radii, channelized lanes, non-skid pavements, reduction of taxi cruising, street car cooperation and rerouting, one-way streets, islands, staggered working hours, education to use mass transportation.

Clifford M. Pinckney, chief engineer of public works, Borough of Manhattan, New York City, enumerated the more recent projects, to facilitate the movement of 750,000 vehicles entering and leaving Manhattan Island daily. Only one line of streets cars is left in Manhattan.

Underground utilities

The report of A. W. Consoer, chairman of the committee on underground utilities, will be made the subject of a general discussion at a future meeting, publication to be asked for in the meanwhile so as to stimulate interest. The three parts of the report relate to (1) general principles governing organization of underground planning agencies, (2) standards for recording data for the preparation of subsurface plans and (3) general standards of design. The aim of the committee is to stimulate underground planning as a definite part of city and regional plans and to aid in the establishment of definite agencies to develop and maintain adequate records.

A.S.A. Building Code Committee Enlarges Its Plans

FURTHER progress in the development of its program, and additional new members were reported by the building code correlating committee of the American Standards Association following its recent meeting. Albert Kahn, architect, Detroit, and William H. Crowell, architect, of A. E. Doyle and Associates, Portland, Oregon, have accepted invitations to join the committee as members-at-large. The American Institute of Architects has named an additional representative, Mellen C. Greeley, architect, Jacksonville, Fla., and Theodore I. Coe, architect, Washington, D. C., as alternate.

As the next step in the building code program, it was recommended that the American Standards Association authorize work on building code requirements for excavations and foundations. The American Society of Civil Engineers has agreed to accept sponsorship of this project in the event that the work is authorized by the ASA standards council.

To develop proper working stresses for building materials, the committee plans to organize a new advisory committee. Data from tests on full-size samples of construction in masonry, steel and other building materials are now being summarized and tabulated. This information, together with data on working stresses assembled by the former building code committee of the U. S. Department of Commerce, will be available to the new committee.

Trench Blasted from Riverbed For Gasoline Line Crossing

Truck-mounted well drills put down holes for 7-ton powder charges that blow out 800 ft. of trench at a time—Pipe welded in long units on shore

A TRENCH 4 ft. deep and 4,240 ft. long was blasted out of the solid rock bed of the Susquehanna River in unusually fast time to receive an 8-in. welded gasoline pipeline, according to an article in the September, 1936, *Du Pont Magazine*, by E. T. Wolf, explosives expert of the du Pont company. Despite unfavorable weather conditions, in two weeks the trench was drilled, blasted and cleaned out, and in another two weeks the pipeline had been welded, laid in place and the trench backfilled.

At the site of the crossing, near High Spire, Pa., 7 miles below Harrisburg, the Susquehanna is four-fifths of a mile wide, and from 3 ft. to 12 ft. deep. The river bed is a sandstone and limestone ledge, covered with a shallow layer of mud and gravel. The line of the pipe was laid out on a slight curve, convex upstream.

In preparation for trenching operations a drill boat sank a line of 6-in. well casings deep into rock at 50-ft. intervals about 50 ft. upstream from the proposed pipeline. A wire rope cable stretched between casings provided a continuous line to which drill boats, work barges and other floating equipment could be anchored at any desired location.

Two truck well-drill rigs, each mounted on a pair of coal barges lashed together, put down a line of 6-in. holes inside of metal casing from 6 ft. to 10 ft. into the rock. A total of 530 holes was drilled on the line of the pipeline at 8-ft. intervals. Each hole was loaded with 5x24-in. cartridges of 60 per cent special gelatin dynamite. Charges varied from 50 to 125 lb., depending upon the depth and character of the rock; the average was 75 lb. per hole.

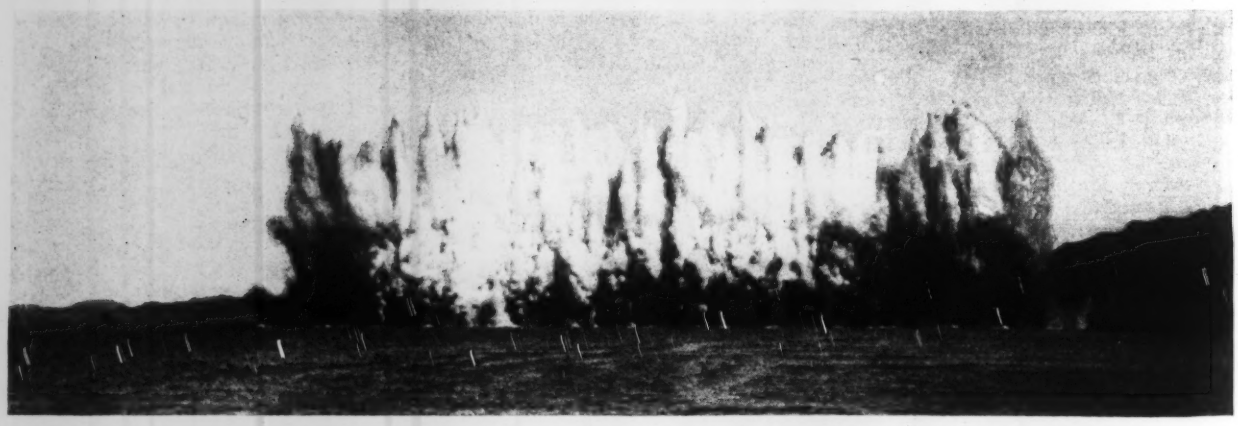
Loading was done from a working barge made up of a pair of coal scows lashed together side by side, with a space of 3 ft. separating the scows which straddled the line of well casings. Test shots indicated Cordeau fuse as best suited to the work in hand, and the primer ends were dipped in a sealing solution to exclude water. To keep all Cordeau connections out of the water the trunk fuse was fastened to a guy line stretched between 2x4-in. wood supports stuck in every seventh well casing.

After a series of holes was loaded and tamped, the intermediate casings between those carrying the fuse guy lines were pulled by means of a chain hoist on a gantry frame spanning the opening between the two scows. In pulling the casings the branch Cordeau line in each hole fell through the shell and was later recovered from the water and hooked up to the trunk fuse line.

The work was progressive from one shore to the other. A series of about 100 holes was fired at a time, opening up a trench section 800 ft. long. As much as 14,000 lb. of dynamite was exploded in a single shot. Following a shot, a clamshell dredge cleaned out rock and other debris that had fallen

WELL DRILLS on trucks carried by barges put down holes within metal casings at 8-ft. intervals for blasting out the trench.

TRENCH SECTION 800 ft. long blasted out of Susquehanna River bottom by 7-ton charge of dynamite for pipeline crossing.



WELDED PIPELINE ready to be rolled off barges into the blasted trench. The spoil banks on either side of the pipeline were used for backfilling the trench after the pipe was in place.

back into the trench, though most of the spoil piled up in parallel ridges on both sides of the line.

Lengths of 8-in. pipe were welded together on shore in units about 550 ft. long. It was necessary to spring the units into a long curve in transporting them around an island close to the welding yard. The units were towed to place on barges, and rolled into the trench. The free ends were held up by gantry chain hoists on the work barges while being welded in the field. The trench was backfilled from the spoil banks after the pipeline had been completed and tested.

The pipeline crossing was placed by the Keystone Pipeline Co. for the Atlantic Refining Co. J. M. Williams, vice-president, and R. B. O'Neal, superintendent, were in charge for the contractor.

Extensive Improvements Aid Buffalo Water System

A PROGRAM to simplify and reduce operating costs of the water system of Buffalo, N. Y., is now under way. The program involves unification of the high and low pressure system and the introduction of increased storage into the distribution system and the filtration plant. The program calls for the erection of three 2,000,000-gal. shallow elevated tanks; installation of three 3,000-gal. per minute electrically driven pumps for the high pressure fire system; construction of an addition to the Clearwater reservoir at the filtration plant; construction of 10,500 ft. of a 36-in. main trunk feeder loop on the north side of the city; and the reconstruction of many distribution mains. This work was described by Alan B. Drake, director of water, Buffalo, N. Y., in a paper delivered before the National Society of Sanitary Engineers convention in Buffalo, Aug. 19.

The water distribution system in Buffalo serves about 101,000 consumers; 19,000 of these are industrial. The average daily consumption is 114 m.g.d. and ranges from 89.5 to 149 m.g.d.

Buffalo has had a municipal water system since 1868, when the plant and properties of the Buffalo City Water Works Co. were purchased. The present plant includes two pumping stations with a combined capacity of 270 m.g.d.; a filtration plant with 160 m.g.d. capacity; and a distribution system comprising 763 miles of pipe. The water supply is taken from Lake Erie through a 12-ft. tunnel.

The city water system has been operated at two different pressures, a high service, operating at 47 lb. per sq.in., and a low service, operating at 30 lb. per sq.in. The high service covers nearly four-fifths of the city. The only storage on the high service has been a 40-ft. standpipe, 80 ft. high. This has had too small a capacity to have any effect on the operation of the system, and it has been used primarily as a balancing reservoir to govern the pumping rate, which is regulated in accordance with water levels in the standpipe. A 116,000,000-gal. reservoir has provided gravity flow in the low pressure system.

There is also an auxiliary booster system which serves a small section of the higher part of the city. In addition the fire department maintains an independent supplementary high pressure fire system, operating at 300 lb. per sq.in., serving the business section of the city.

Unification of the system

The National Board of Fire Underwriters has for several years advocated the unification of the high and low pressure services, so as to insure an average pressure of 60 lb. in the business district and to increase the pressure throughout the system. Since, in combining the services, all division gate valves between the systems would be opened, which would give generally lower friction losses and higher pressures throughout the system and reduce the number of maintenance operations, it was considered desirable to make this change. The change was considered especially desirable inasmuch as the maximum difference of elevation within the city limits is only about 130 ft.

The increased pressure automatically eliminated the reservoir which had been used in the low pressure system. Since the reservoir, isolated, would constitute a danger to public health, it is being filled in and the site converted into a recreation center and stadium. This is being done as a WPA project.

The elevated tanks

To provide storage in the unified system, three tanks, each of 2,000,000 gal. capacity, are being installed in different sections of the city. The tanks are connected directly with trunk mains and are placed at such heights that they all lie in the same hydraulic plane, so that all three tanks ride on the system operating as a unit. However, since the distances between the tanks and the varying consumption rates from day to day make it impossible to keep the tanks permanently on the same hydraulic plane, the tanks are equipped with automatic valves to prevent overflow.

The three tanks, which are identical in design, are of the shallow type. They are 122 ft. in diameter and have a range in head of only 25 ft. between the upper and lower levels. All the tanks are connected directly to 36-in. trunk mains in the distribution system through 24-in. pipes, which are provided with 16-in. automatic hydraulically-operated, cone-type check valves, located at the foot of each tank.

Telemeters are being installed in all the elevated tanks and in the old standpipe to provide the operating department with complete information regarding the pressures in the system and the elevations of the water level at all the tanks. These telemeters operate four pressure gages in the pump room and four recording gages in the chief engineer's office.

The installation of this elevated storage, together with the unification of the system into one service, will insure an average pressure in the distribution system of 60 lb. per sq.in., with a minimum of 30 lb. and a maximum of 75 lb. It is expected that this increase in pressure will materially decrease fire losses and reduce fire insurance rates.

Two of these tanks are now in service, and the third is in process of erection. The foundations and the 24-in. connecting pipes of these tanks were constructed as a WPA project.

New pumps for fire system

In connection with the improvement program, three additional pumps for the high pressure fire system have been installed to bring the fire system up to the requirements of the National Board of Fire Underwriters.

These are electrically driven centrifugal pumps of 3,000 gal. per minute capacity, operating at 300 lb. per sq.in. pressure.

All the high pressure lines, valves, and other hydraulic equipment at the station are installed in duplicate, so that a failure at any point will not tie up more than one pump. The power cables feeding the pump motors are laid in duplicate and are fed from separate substations. The pumps are installed in a pit, at an elevation low enough to assure their ability to lift water from the lowest recorded lake level. The pit is surrounded by a watertight wall high enough to prevent flooding the motors if a break should occur at the pumping station, and the switching equipment is mounted on an elevated platform.

Improvements to distribution system

For the past three years a program of modernization of the distribution system has been under way. About 67,000 lineal feet of main, ranging from 6 in. to 36 in. in size, has been laid; much of this pipe is replacement of old small pipes which have outlived their useful life. Included in this pipe laying is the installation of a 36 in. steel trunk main 10,500 ft. long, which completes a feeder belt along the northern border of the city.

This pipe is made up of ¼-in. steel sheets with electrically welded longitudinal seams. The field joints were made with bolted sleeve-type couplings; the pipes were coated with bitumastic enamel, applied while spinning the pipe.

The existing filter plant, built in 1926, was designed to meet the needs of the city until 1936. In accordance with the plans made then, the Clearwater reservoir is being enlarged.

The present extension is a covered reservoir 460x280 ft., nearly doubling the size of the existing reservoir. The new extension will give an additional storage capacity of 12½ million gallons of water. The structure has vertical reinforced concrete walls and a reinforced concrete roof supported by 286 concrete columns founded on rock. The floor is plain concrete laid directly on rock. When completed, the structure will be covered with earth and landscaped.

The increased reservoir storage will make it possible to run the filter plant at a more uniform rate and thus postpone installation of additional filter units. The possibility of hot weather water shortage will be greatly reduced.

Construction of this reservoir extension is being carried by the WPA.

From Job and Office

Adjusting Rough Traverses

By Lawrence Pratt
Engineering Draftsman, Tennessee Valley Authority

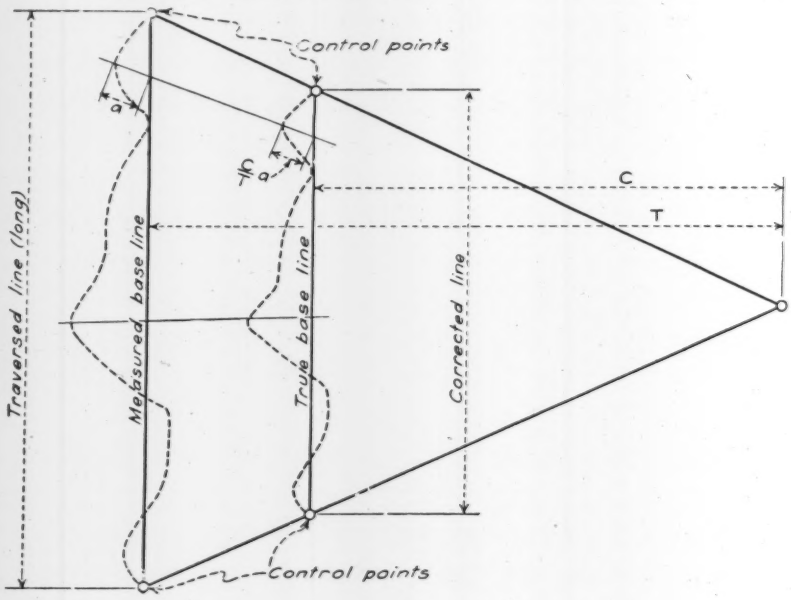
IN PLANE TABLE traversing of steep mountain trails where the distances are obtained by pacing or with a rope, it often happens that the closing error between any two control points will be large. The method illustrated in the accompanying sketch takes but little time and gives a continuous correction for this condition.

The traverse is traced from the field sheet, and rays are drawn to the control points from any convenient point: the angle at the center of rays should not exceed ninety degrees. The two ends of the traverse are connected by a base line, and a line is drawn parallel to this and at a distance such that its length as intercepted by the rays is the true distance between control points. From convenient points on the traverse rays are drawn to cut the base lines.

Corresponding points on the original and the corrected traverse lines will lie on the same ray and the distance of each of the points from its own base line will be in the same ratio as the ratio of the distances from the center to the base lines.

Thus, in the sketch, if C is the distance from the center to the corrected base line, T is the distance from the center to the original base line, and a is the distance from any point on the original traverse line to its base line, then $\frac{C}{T} \times a$ is the distance of the corresponding point on the corrected traverse from its base line. Corresponding lines of the two traverses will be parallel.

A simple graphical adjustment for rough traverses between control points.



Cleaning Expansion Joints

By Edward N. Hines
County Road Commissioner, Wayne County, Michigan

DURING HOT WEATHER the asphalt fiber joints in our concrete pavements are squeezed up, causing a ridge on the surface of the road which is very annoying to traffic. Elimination of these ridges, by cutting off the surplus material, is a difficult problem, particularly on a new pavement during the first hot spell after construction. Originally we attempted to cut off these ridges by hand, using a sharp spade, but without much success.

About six years ago we developed a tool in the form of a light plow which has proved very successful. This tool, as may be seen in the illustration, consists of a 6 in. piece of grader blade sharpened to a cutting edge and attached to one end of a piece of iron bent in the form of a hook. The other end of the hook is provided with a device for attaching to a light tractor. A long handle is attached to the hook by means of which the operator guides the tool. This device has proved very efficient and provides a simple method for taking care of an annoying problem.

A SIMPLE DEVICE for cleaning expansion joints.

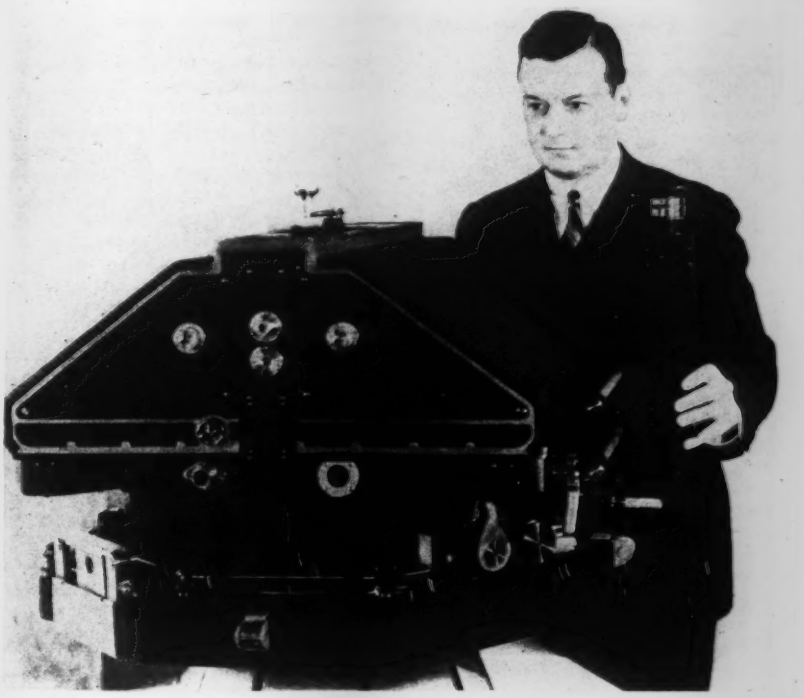
Multi-Lens Camera for Aerial Mapping

A LARGE CAMERA, developed for the U. S. Coast and Geodetic Survey, for aerial mapping, would be capable of photographing 600 sq.mi. of terrain in a single exposure, from an elevation of 30,000 ft., if it were practical to work at that altitude. Because of the arrangement of its nine lenses and eight mirorrs the camera is able to expose a film which has a negative size of 23x23 in. Other multi-lens cameras require a separate film for each lens. The 9-lens camera, flown at 13,750 ft., can photograph a strip 11.05 mi. wide with 1,020 exposures on the same scale that would require 7,350 exposures by a 5-lens camera, flown over a 10.15-mile strip, at an elevation of 10,000 ft.

A longer focal length, 8½ in. rather than 6 in., is made possible by the vertical lenses and mirrors of this camera. In the five-lens cameras, such as were discussed in *ENR*,, Sept, 5, 1935, p. 342, four lenses are set at angles and one vertically. The 10-lens camera consists of two 5-lens cameras set on a common mount, and to date has been used principally for reducing the amount of ground control necessary in an aerial survey. It can be used for mapping projects from a lower altitude and for military reconnaissance. The 9-lens camera does not photograph as large an area as the 10-tens, or tandem camera, but secures greater detail, which is essential for mapping.

Fairchild Aerial Camera Corporation engineers, in conjunction with Lt. O. S. Reading, U. S. Coast & Geodetic Survey, developed the camera, which weighs 305 lb. and is 38 in. high. The camera is fully automatic and the 200-ft. roll of film, sufficient for 100 exposures, can be loaded in daylight. It is equipped with spirit levels for keeping it on an even plane, a telescopic view finder, with drift indicator, and automatic overlap control. Overlap is automatically taken out in the laboratory by a transforming printer. Electric motors, perfectly synchronized and working through an Intervelometer, operate each of the nine shutters. The eight, astronomical type, steel mirrors are each 9½ in. long and 5 in. wide. They are coated with evaporated aluminum to raise the factor of reflectivity and are mounted at an angle of 19 deg. from the vertical to increase the coverage of the wing lenses. With this camera, it is practical to secure contour maps from aerial photographs over more level terrain than is possible with present equipment.

THIS AERIAL CAMERA can photograph 600 sq. miles in one exposure



CURRENT HIGHWAY PROBLEMS—V

Future Federal Aid

Highway aid from the federal government should be based on conditions as found in normal times and on expected traffic requirements without regard to depression or inflation periods

By H. G. Shirley
Commissioner, Virginia Department of Highways, Richmond, Va.

FEDERAL AID *in roadbuilding has always presented problems. How it should be distributed, what the federal share should be, how far federal control should extend and even whether federal aid is desirable have always been disputed questions. In general these disputes have submitted to reasonable compromise and never have they threatened the existence of federal aid as a desired governmental policy. This was the regime of normal federal aid from 1916 to 1930, and then a new order was established — an emergency regime. Large sums of money were provided, not as the federal share in a partnership with the states, but as a donation to increase and spread employment by roadbuilding. It was stipulated precisely when, where, and how the gift money was to be spent and the work performed; the old partnership administrative organization was retained but put under a superadministration created for emergency purposes. Out of the new relationship in federal and state direction and control of roadbuilding comes now the question of retaining or discarding certain practices of the emergency period. Shall definition of classes of roads and restrictions as to cost, employment, wages, hours and handwork be retained or discarded? These are the questions answered in the article that follows, and answered with a positiveness that bears out the reputation of the author for independent thinking and frank speech*— EDITOR.

MANY VITAL PROBLEMS have to be worked out in planning future federal aid to roadbuilding. Prior to the depression federal aid on a joint investment basis with the states had become an established policy. Then to relieve depression unemployment federal aid took the form of a works relief appropriation with an extrapolation of conditional allotment as to classes of roads and restrictions as to cost, employment, wages, hours, handwork, etc. A return was made to regular federal aid in the laws of 1935 and 1936 but with extensions and conditional features. So it is very difficult, considering conditions in 1936 and particularly the great part played in the last few years by roadbuilding as a dominating works-relief resource, to formulate a logical or even a reasonable plan of future federal aid. The writer believes, however, that the problem should be approached without regard to depression or inflation periods and the solution should be based on normal times and the expected requirements of traffic.

Original objectives

It helps to clarify the problem if the original purpose and the developed objectives of federal aid are made plain. When the federal-aid law was passed by Congress in 1916, the prime object to be accomplished was to develop an adequate highway department in each state. This was accomplished with surprising speed; an efficient department had been organized in every state by 1917 and in most states a system of state highways had been laid out, and from this mileage a selected system of federal-aid roads was formed.

The operation of the federal-aid act, under the Secretary of Agriculture and the Bureau of Public Roads, was undertaken with the definite idea that it was a cooperative measure to assist the states and to give them the benefit of expert advice and of the results of experiments carried on by the bureau. Rules and regulations covering the conduct of the work were simple, not restrictive and in no way interfering with state regulations and labor conditions. Much was accomplished under this law and the guidance of the Bureau of Public Roads.

A few years after the state and federal-aid systems had been selected in the various states and a considerable mileage had been constructed, there was a demand for interstate roads or national highways. This demand became so insistent that a campaign was begun to promote the construction of a national-highway system by the United States government. To meet this demand a larger appropriation was made by Congress for federal aid, and the Bureau of Public Roads encouraged the construction of roads that would provide interstate connections. This action had the wholesome effect of building the main trunk roads of the country first and providing a system of national highways brought about through federal aid rather than at federal expense alone.

The cooperation between the state departments and the Bureau of Public Roads during this period was most friendly and very great results were accomplished at a minimum cost, demonstrating beyond a doubt that if federal participation were to take place it should be on a cooperative plan, based on reasonable rules and regulations, and devoid of unreasonable restrictions.

As the mileage of improved roads increased, there was a further demand for continuous numbered routes that would go from one end of the country to the other. In the absence of either federal or state laws bearing on this matter, the Secretary of Agriculture was requested by the American Association of State Highway Officials to see what could be worked out. He appointed a committee from the membership of this association and the staff of the Bureau of Public Roads to study the subject and report. The committee divided the country into zones and held public meetings after which it formulated a report to the secretary with recommendations. The secretary approved the recommendations and sent them back to the various states with a request that they be adopted, and that the routes as recommended be laid out and numbered. In a year's time most of the routes selected had their numbers posted from east to west and north to south.

Again the work was accomplished without any definite law authorizing the Secretary of Agriculture and the Bureau of Public Roads to undertake such a task, and, so far as I know, without any state law definitely clothing its highway department with authority. It was a cooperative effort on the part of the federal government and states and the results were secured in the shortest time possible, at practically no cost to the government or the states, except possibly some traveling expenses by the

FEDERAL FUNDS AUTHORIZED FOR HIGHWAY IMPROVEMENT AND ADMINISTERED BY THE DEPARTMENT OF AGRICULTURE

Year	Federal Aid	Forest Roads and Trails	Emergency Advances	Recovery Funds	Emergency Relief	Total
1917.....	$5,000,000	$1,000,000	.....	.....	.....	$6,000,000
1918.....	10,000,000	1,000,000	.....	.....	.....	11,000,000
1919.....	65,000,000	4,000,000	.....	.....	.....	69,000,000
1920.....	95,000,000	4,000,000	.....	.....	.....	99,000,000
1921.....	100,000,000	4,000,000	.....	.....	.....	104,000,000
1922.....	75,000,000	6,000,000	.....	.....	.....	81,000,000
1923.....	50,000,000	11,000,000	.....	.....	.....	61,000,000
1924.....	65,000,000	7,500,000	.....	.....	.....	72,500,000
1925.....	75,000,000	7,500,000	.....	.....	.....	82,500,000
1926.....	75,000,000	8,500,000	.....	.....	.....	83,500,000
1927.....	75,000,000	7,500,000	.....	.....	.....	82,500,000
1928.....	75,000,000	7,500,000	.....	.....	.....	82,500,000
1929.....	75,000,000	7,500,000	.....	.....	.....	82,500,000
1930.....	75,000,000	7,500,000	$80,000,000	.....	.....	162,500,000
1931.....	125,000,000	15,500,000	.....	.....	.....	140,500,000
1932.....	125,000,000	12,500,000	120,000,000	.....	.....	257,500,000
1933.....	125,000,000	17,500,000	.....	$400,000,000	.....	542,500,000
1934.....	.....	25,100,000	.....	200,000,000	.....	225,100,000
1935.....	.....	10,000,000	.....	.....	$400,000,000	410,000,000
1936.....	125,000,000	10,000,000	.....	.....	.....	135,000,000
Totals...	$1,415,000,000	$175,100,000	$200,000,000	$600,000,000	$400,000,000	$2,790,100,000

men who selected the routes and the cost of signs.

I know of no large undertaking that could have been accomplished as speedily as this except by cooperative effort and it is the belief of the writer that had time been taken for Congress and the state legislatures to pass laws the work would not have been completed by this date and today we would only have a partly marked U.S. road system. The result shows the benefit of not having too many laws and regulations to control cooperative effort.

Basis of future aid

A conservative estimate of the necessary funds to carry on an ordinary program of highway maintenance and construction on primary and secondary roads in the United States, is $1,750,000,000 a year. This includes all public roads under the supervision of public officials, townships, county and state. The maintenance of these roads and bridges will cost about $500,000,000 yearly. This would leave $1,250,000,000 per year that should be used for construction. Federal aid should be continued, and used to assist in the construction and maintenance of interstate routes, the government paying 50 per cent of the total cost. The states should match the government's half on interstate highways within their borders and assist the counties and subdivisions on a cooperative fifty-fifty basis with all other roads.

The present plan of allotment of federal aid to the various states has worked satisfactorily and it should be continued. It would be exceedingly difficult to establish a new plan that would meet with as general approval as the one heretofore used. There have been appropriated since the passage of the first federal-aid law the amounts (including forest roads, emergency advances, etc.), totaling $2,790,100,000, as shown in the accompanying table.

The type of surface and the method of construction and maintenance of any section of interstate highway should be left to the discretion of the Bureau of Public Roads and the state highway departments. Also the question of cost of any section of interstate road should be left to be determined by the Bureau of Public Roads and the state highway departments. Types, hours of labor, wages, the manner in which the work should be done, whether by hand labor or machines should positively be left to the highway departments and the Bureau of Public Roads to work out together. In my judgment it would be most unfortunate and fallacious for the government, through any department or bureau, to try to establish a uniform wage scale throughout the country, or uniform hours of employment or to specify hand labor instead of the use of machinery. Any such restriction would increase cost, cut down the amount of employment, reduce wages in many instances and altogether be most unsatisfactory. It would be very much better to discontinue federal aid altogether.

The object of continuing federal aid is to encourage and assist the states in constructing and maintaining those roads that should be constructed to take care of interstate traffic. There has been a steady increase with only slight fluctuations in the volume of traffic since the advent of the motor vehicle, and so far as the writer can see this increase will keep up for a number of years to come. To take care of the increase in traffic and use of the roads by the improved vehicle will require a serious effort on the part of the government and the states. The burden of maintenance has been borne by the states but it is only fair that the government should stand its part on interstate routes.

Administration of aid

The government should have supervision over all federal expenditures to see that they are properly made. It should approve the sections of road and the types of roads to be constructed and should maintain proper inspection to see that the provisions of the plans and specifications are carried out; but, further than this any control or restriction by law, rules and regulations will greatly reduce the efficiency of the contractor, increase the cost of the work and delay its completion. It would be far better that no federal aid be received than to be strangled with rules and regulations that have already become so complicated and voluminous that they are unwieldly, unintelligible and burdensome. It is the advice of the writer that the federal government destroy all the rules and regulations heretofore promulgated for federal aid, the states doing likewise, and then in cooperation rewrite simple ones, again reinaugurating a cooperative movement that has done more to advance the welfare and prosperity of the people of the United States than any other public work ever undertaken.

A profound and highly learned man told the writer during a consultation that "all laws are restrictive". Rules and regulations drawn to cover every little detail are painfully so. I cannot impress this fact too strongly because it determines whether the rules and regulations adopted by the government will create great burdens to be carried by the highway departments and passed on down to the people, or whether simple rules and regulations shall be adopted controlling the administration and expenditure of funds but allowing the work to proceed with the least delay in the most efficient way to secure the highest results.

Dredge Pumps at Fort Peck Changed in Fast Time

THE DREDGE PLANT maintenance crews at Fort Peck dam have so perfected their procedure that the record time for changing all five pumps in a dredging unit (two on the dredge, two on the floating booster, one on the land booster) has been reduced to 5 hr. 12 min. This record was made in a pump change on Oct. 5. A year ago the dredge units were shut down for 16 hr. at a time for pump changes, while early in this year's dredging season the change time had been reduced to 8 hr. To effect the pump changes one of the two 25-ton floating derricks is moored alongside the dredge, the other is made fast to the floating booster. The derricks lift the 21-ton pumps bodily out of their positions in the hulls and set them down on the decks of work barges. Rebuilt pumps are picked up and set in their places, after which workmen quickly screw up the nuts and bolts with pneumatic wrenches. Pumps on the land boosters are handled by temporary gantry cranes. Each pump in the dredging fleet must be removed and rebuilt after it has handled about one million yards of material.

Book Reviews and Notes

A Monthly Commentary on Current Additions to the Civil Engineer's Library

A Study of Engineers

THE PROFESSIONAL ENGINEER — By Esther Lucile Brown. Board; 5x8 in.; pp. 86. Published by Russell Sage Foundation, New York. Price 75c.

A FEW YEARS AGO the Russell Sage Foundation began a study of the professions for the use of "vocational counselors and those who are striving to make the professions contribute more widely to the welfare both of their members and of society." This study is the second to be published. In its less than 100 pages it gives a concise factual statement concerning the education of engineers, their national societies, their number, the demand for their services, and their salaries. The information comes from a variety of authoritative sources. Much of it is not new to engineers but they will find it interesting because of the author's detached point of view. In the concluding section, Miss Brown looks into the future and sees a continuing decrease in private engineering practice but an ever expanding field of usefulness for engineers in industry at salaries not as attractive as the income from private practice in prosperous times but relatively remunerative to an increasingly large number of men.

Handbook of Engineering Fundamentals

HANDBOOK OF ENGINEERING FUNDAMENTALS—By Ovid W. Eshbach. Fabricoid; 5½x8½ in.; pp. 837; linecuts and tables. Published by John Wiley & Sons, Inc., New York. Price $5.00.

AN INTERESTING and useful reference book has been produced by segregating from various current engineering handbooks the sections dealing with "fundamentals," that is, mathematics, physics, chemistry, mechanics, data on materials, and the like. The resulting "Handbook of Engineering Fundamentals" is rather formidable in bulk, but it will be found to contain many items of information not always conveniently available. While the completeness of the information given in some instances is apt to prove disappointing, this perhaps is difficult to avoid in a condensed reference manual.

The compilers of the work appear to have had the needs of the mechanical and electrical engineer primarily in mind. The civil engineer will have to look elsewhere for many necessary data. To select one or two detail instances at random: In hydraulics he will look in vain for formulas for flow in pipes; in materials for information on bituminous materials or road oil; in meteorology for a usable wind-pressure formula; in structural analysis for mention of truss frames. He will also find nothing on such recently developed "fundamentals" as soil physics or mechanics.

In general the editor of the volume and his collaborators have succeeded well in excluding matters of engineering judgment and practice from inclusion with the "fundamentals," but not always. Steel column formulas and working stresses are given, for example, and so are design methods (and even safe-load tables!) for reinforced-concrete beams, slabs and columns. Caution is advisable in using such information as fundamental data material.

Industrial Dust Control

INDUSTRIAL DUST—By Philip Drinker and Theodore Hatch. Cloth; 6x9 in.; pp. 316; photographs, charts, tables. Published by McGraw-Hill Book Co., Inc., New York. Price $4.00.

THE DUST HAZARD is one of industry's greatest worrys at present. The spread of occupational disease compensation acts, the unsavory publicity given silicosis cases and the ever-increasing knowledge of the health hazard of dusts have brought dust control to the fore as a very important industrial problem. Volume upon volume has been written about industrial dusts and silicosis, hundreds of papers have been presented at technical sessions, and pamphlets and booklets on the subject have been produced by the score. Despite the abundance of literature, dust and dust control are but little understood by those upon whom the responsibility rests for ridding industry of its chief health hazard. Why? Because most of the literature has been written from the medical and health aspect and not from the standpoint of practical dust control.

Drinker and Hatch have supplied a practical treatise on dust control—that is, as practical a document as can be expected from two health school professors. At least they made an honest effort to make the book practical, and have succeeded admirably well in comparison with previously published works. The authors succeeded in breaking away from too technical medical discussions, and have included plenty of sound, sane engineering material. In fact, the book is for the practical man and the engineer, not for the medical profession.

Yet, because dust control is so closely associated with characteristics of dusts and the effect of dust upon the human body, the authors have necessarily included much physiological material. Without an understanding of the health hazard the engineer responsible for dust control is handicapped. The book opens with a discussion of physical properties and characteristics of dusts, fumes and mists. Particle size, flocculation, settling velocities and electrical properties of dust are discussed from an engineering viewpoint.

The effects of dusts and fumes upon man are covered extensively, to bring out the physiological factors of the dust hazard. This discussion ends in a chapter on permissible dustiness, a controversial point in dust control. All the known means of determination of dust concentration are given in explicit detail, probably in excess of practical use because of the standardization upon the impinger method now used in this country.

The last half of the book is of the greatest value to the practical man, for here the methods of control of industrial dusts are treated thoroughly. Unfortunately, the practical methods of rock drill dust control are rather skimpily covered, but there is enough material on rock drilling presented to warrant the attention of the construction, mining and quarry fields. The engineering design of exhaust systems is presented in an excellent manner, as complete as can be found in most handbooks on the subject. Respirators and air-cleaning devices come in for their share of discussion.

One of the chief values of the book is in bringing together under one cover all of the factors affecting dust control. An extensive bibliography given in the last pages is of unestimable value to those interested in the solution of industry's dust hazard problem.

Miscellaneous Notes on Booklets and Reprints

ACTIVITIES OF STATE HIGHWAY DEPARTMENTS in the interests of highway safety are described in a 15-page pamphlet, "Safety on the Highways," published by the American Association of State Highway Officials, Washington, D. C.

GEOLOGY AND GROUNDWATER RESOURCES of the Elizabeth City area, North Carolina, are described by F. W. Lohman in a Geological Survey pamphlet of that name. The pamphlet is a report of investigations which were made as to the availability and salinity of groundwater

for use as a possible supplement to the water supply system of Elizabeth City, North Carolina.

THE BUSINESS MAN AND HIS REGIONAL PLAN, an address by A. P. Greensfelder, has been printed by the University of Illinois, Bulletin No. 50, Urbana, Ill.

VITRIFIED PAVING BRICK: simplified practice recommendation R1-36, superseding R1-35. (Superintendent of Documents, Washington, D. C., price, 50c.).

NORRIS DAM is the subject of a pamphlet published by the Tennessee Valley Authority obtainable from the Superintendent of Documents, Washington, D. C. Price 15c. The pamphlet is largely pictorial.

SOIL MECHANICS STUDIES and related experiments and investigations carried on by the geotechnical committee of the Government Railways of Japan are outlined in Bulletin No. 4, Research Office, Government Railways of Japan, Tokyo.

BRIDGES OR TUNNELS — WHICH?, a pamphlet published by the American Institute of Steel Construction, New York, is devoted chiefly to a comparison of the cost per lane of traffic of large bridges and vehicle tunnels.

RAPID TRANSIT FOR SAN FRANCISCO, a report to the San Francisco Public Utilities Commission, has been printed by the commission in pamphlet form. The report was prepared by E. G. Cahill, manager of utilities, and includes as an appendix the report of Robert Ridgway and Alfred Brahdy submitted to the Commission in July of last year.

THE RELATION BETWEEN RAINFALL AND STEAMFLOW is the subject of a paper published in two parts in the Sept. 1934 and April 1936 issues of the *Monthly Weather Survey* (single copies 15c. from the Superintendent of Documents, Washington, D. C.). The paper is an involved mathematical discussion of the subject.

THE FEDERAL POWER COMMISSION has issued as part of its electric rate survey a glossary of "Important Power and Rate Terms, Abbreviations and Units of Measurement." (Price 5c., Superintendent of Documents, Washington, D. C.). It also has published Power Series No. 6 of the National Power Survey, "Statistics of Electric Generating Plants in the U. S., 1920-1935 inclusive." This pamphlet is not available for general distribution but may be consulted as a public record in some of the major libraries of the country.

FORESTS AND FLOOD CONTROL is the subject of a supplementary report made to the committee on flood control of the House of Representatives by the U. S. Forest Service. Copies may be obtained from the Forest Service or the Superintendent of Documents, Washington, D. C.

TERMITE EXTERMINATORS as a fire and health hazard are discussed in a pamphlet entitled "Termites in This Country," put out by the America Fore Group, 80 Maiden Lane, New York. The pamphlet points out how quack exterminators, through the use of inflammable gases and poisonous powders are making termites a hazard for insurance agencies. The pamphlet also reprints some recent government documents and articles relating to termites.

STUDIES ON CHEMICAL PRECIPITATION OF SEWAGE made at the Dallas treatment plant by the Texas Engineering Experiment Station are reported in Bulletin 44, copies of which can be obtained free of charge by addressing requests to F. E. Giesecke, director, at College Station, Tex. Reports covers experiences with a number of coagulants, and their action on strong sewage containing considerable quantities of industrial waste.

THE EXTENT OF SILTING IN AMERICAN RESERVOIRS is being studied by the Soil Conservation Service. A report of the results to date of the survey is given in a bulletin of the Department of Agriculture, "Silting of Reservoirs," by Henry M. Eakin. The work done so far has been confined to the Southern States. The present report, in addition to a general discussion of the subject, gives detailed figures on each of the reservoirs studied and, in many cases, also gives topographical maps of the reservoirs.

METHODS OF GEODETIC SURVEYING are described in considerable detail in a 160-page book prepared as a WPA project by the Massachusetts Geodetic Survey entitled "Technical Procedure for Geodetic Surveys." Complete specifications are given for first, second, and third order triangulation, traversing, and leveling. Tables and formulas are appended for the calculations most ordinarily met with in this type of work.

New Books and Revised Editions

[Those desiring copies of the books listed below or mentioned elsewhere in this section should order them from the publishers or from their local booksellers.]

TECHNICAL DRAWING PROBLEMS—By Frederick E. Giesecke, Alva Mitchell and Henry C. Spencer. Paper; 9x11 in.; pp. 93; linecuts. Published by The Macmillan Co., New York. Price $1.40.

PUBLIC FINANCE—By Alfred G. Buehler. Cloth; 6x9 in.; pp. 632; linecuts. Published by McGraw-Hill Book Co., Inc., New York and London. Price $4.00.

THE STEEL PHYSICAL PROPERTIES ATLAS—By Charles Newman Dawe. Cloth; 8½x11 in.; pp. 87; tables, color charts. Published by the American Society for Metals, Cleveland, Ohio. $0.00. . . . *Physical properties of the various types of plain carbon and alloy steels are tabulated and graphically represented. The book permits easy determination of the various properties as affected by carbon content, alloy content, heat treatment, etc.*

THEORY OF ELASTIC STABILITY—By S. Timoshenko. Cloth; 6x9 in.; pp. 518; halftones, linecuts and tables. Published by McGraw-Hill Book Co., Inc., New York and London. Price $6.00.

MOVING THE EARTH—By Charles Pierce Burton. Cloth; 5x8 in.; pp. 255; photographs and linecuts. Published by Henry Holt & Co., New York. Price $2.00 . . . *A book for boys on mining and construction operations of many kinds.*

THE NATION'S WATER SUPPLY—By R. C. S. Walters. Cloth; 6x9 in.; pp. 244; halftones, linecuts and maps in color, tables. Published by Ivor Nicholson & Watson, Ltd., London. Price £1.11.6.

ENGINEERING GEOLOGY—Fifth Revised Edition. By Heinrich Ries and the late Thomas L. Watson. Cloth; 6x9 in.; pp. 750; halftones, linecuts, tables. Published by John Wiley & Sons, Inc., New York. Price $5.00.

HYDRAULICS—By Charles W. Harris. Cloth; 6x9 in.; pp. 220; halftones, linecuts, tables. Published by John Wiley & Sons, Inc., New York. Price $2.75.

LESSONS AND PROBLEMS IN ELECTRICITY—By Newell C. Page. Cloth; 5½x8½ in.; pp. 356; linecuts, tables. Published by The Macmillan Co., New York. Price $2.75.

SOIL EROSION AND ITS CONTROL—By Quincy C. Ayres. Cloth; 6x9 in.; pp. 365; halftones, linecuts tables. Published by the McGraw-Hill Book Co., New York. Price $3.50.

THE TECHNOLOGY OF ALUMINUM AND ITS LIGHT ALLOYS—By A. V. Zeerleder. Cloth; 6x9½ in.; pp. 301; halftones, linecuts, tables. Published by Gustav Fock, New York. Price $5.50.

SEEHAFENBAU—Lieferung 1 (Bogen 1 bis 5)—Band II. By F. W. Otto Schulze. Paper; 7x9½ in.; pp. 80; linecuts. Published by Wilhelm Ernst & Sohn, Berlin, Germany. Price 4.15 RM.

STUTZMAUERN GRUNDBAU—Lieferung 5 (Bogen 25 bis 30)—Vierter Band. Paper; 7x10½ in.; pp. 94; halftones, linecuts, tables. Published by Wilhelm Ernest & Sohn, Berlin. Price 6 RM.

NEW YORK ADVANCING A SCIENTIFIC APPROACH TO MUNICIPAL GOVERNMENT. An accounting to the citizens by the departments and boroughs of the City of New York, F. H. LaGuardia, Mayor. Paper; 6x9½ in.; pp. 368; halftones, linecuts, tables. Published by Municipal Reference Library, New York. Price 50c.

DAS TRINK-UND GEBRAUCHSWASSER—By G. J. Lehr. Cloth; 7x10 in.; pp. 304; halftones, linecuts, tables. Published by Wilhelm Engelmann, Leipzig, Germany. Price 24 RM in Germany.

THE PORTS OF SAN DIEGO AND SAN LUIS ORISPO, CARLIFORNIA—Port Series 13, Part 2, revised 1936. Prepared by the Board of Engineers for Rivers and Harbors, War Department. Paper; 6x9 in.; pp. 131; halftones, linecuts, tables, maps. For sale by Superintendent of Documents, Washington, D. C. Price 30c.

BOECKH MANUAL OF APPRAISALS—BOECKH LOCAL INDEX CALCULATOR. Published by the Rough Notes Co., Inc., Indianapolis, Ind. Price for Manual with pad and appraisal work sheets $5.00. Price of Index Calculator with pad of index work sheets, $3.50.

DEFICIENCIES IN BASIC HYDROLOGIC DATA—September, 1936. Report of the Special Advisory Committee on Standards and Specifications for Hydrologic Data. Paper; 9x11 in.; pp. 66; halftones, linecuts, tables, maps. Published by National Resources Committee. For sale by Superintendent of Documents, Washington, D. C. Price 30c.

Letters to the Editor

Mosquitoes and Salt Water

Sir—In "Mosquito Control Engineering . . . III," by Russell W. Gies, on page 225 of the Aug. 13, 1936, issue of *ENR*, appears this statement: "Fresh water varieties (of mosquitoes) are seldom found in water of greater salinity than about 6 per cent."

According to *The Columbia Encyclopedia* (1935), the average salt content of ocean water is about 3 per cent. *The Lincoln Library of Essential Information* (1934) states that "salt water contains about 3½ per cent of dissolved mineral matter, over three-fourths of which is common salt."

In view of the fact that the salinity of ocean water is less than 6 per cent, am I correct in assuming that fresh water varieties of mosquitoes are found in ocean water?

FRANK M. WALLING

Meadville, Pa.
Sept. 8, 1936

SALT CONTENT AND SALINITY DIFFER in meaning in this respect: the latter refers to the degree of saltness, or per cent saturation, while salt content is a statement of the actual amount of salt present in a solution without any relation to a saturated condition. A saturated salt solution contains about 26 parts of salt per 100 parts of water and the density of this solution, measured by a salinometer, is called 100 per cent salinity. A 6 per cent salinity, therefore, would contain .06 x 26 = 1.56 parts of salt per 100 parts of water; thus the salt content is 1.56 per cent.

Mr. Walling correctly states that ocean water contains about three parts per hundred of *salt content*. However, this is more than twice the value represented by 6 per cent *salinity*, and consequently fresh water mosquitoes will find conditions unfavorable for breeding in ocean water.—EDITOR.

Discontinuous-Web Girder Design Outlined

PUBLICATION some months ago (ENR—April 30, 1936, p. 623) of an article by the late J. C. Meem setting forth a design procedure for discontinuous-web girders brought in several letters which took issue with the method. All pointed out that the spacing of the plates which Mr. Meem obtained and assumed to be in feet was in reality in inches. These girders have been principally used for temporary bracing across subway excavations in New York, and the letter below expresses the design method used by the Board of Transportation, to check their adequacy. It differs materially from that presented by Mr. Meem.—EDITOR.

Sir: The design of a discontinuous-web girder, may be said to be similar to that of a battened column, of towers with horizontal struts only, or of a Vierendeel truss. Considering the girder as a whole, it is subjected in addition to the flange stresses to moments at the joints, due to the fact that portions of the web are omitted and are not replaced by diagonals. These moments may be determined from the shears and points of contra-flexure of the component parts of the girder. For chord angles of the same size throughout and tie plates spaced at equal distances, the points of contra-flexure in the angles may be assumed midway between the plates.

On this basis the stresses in the angles and rivets may be obtained in the following manner. Referring to the accompanying sketch, which is a view at one end of the girder, shear,

$$S_1 = R_1 - \frac{WF}{2} \qquad (1)$$

Vertical load per rivet in Group B =

$$\frac{\frac{S_1}{2} + \frac{WF}{2}}{N} = V_1 \qquad (2)$$

Moment on rivets in Group B =

$$\frac{S_1}{2} \times \frac{F}{2} + \frac{WF}{2} \times \frac{F}{4} = \frac{S_1F}{4} \times \frac{WF^2}{8} = M_1 \qquad (3)$$

Vertical stress on extreme rivet D =

$$\frac{\frac{S_1F}{4} + \frac{WF^2}{8}}{S.M.} = V_2 \qquad (4)$$

Where $S.M.$ = section modulus of the rivet group. Horizontal stress on this group of rivets =

$$\frac{RF}{2} - \frac{WF^2}{h} = C_1 \qquad (5)$$

C_1 is also the total compression on the upper flange angles at this point.
Horizontal stress per rivet =

$$\frac{C_1}{N} = H_1 \qquad (6)$$

The maximum bending moment, M_2, on the upper flange angles will be at a point to the left of rivet D where the shear passes through zero. This will be at a rivet distance E from the centerline of the support.

The vertical stress on this rivet plus the vertical stress on the rivets to the right of it is equal to the sum of the downward loads to the right of this rivet acting on the upper pair of angles. The maximum unit stress on the upper flange angles =

$$\frac{M_2}{2m} + \frac{C_1}{2A} \qquad (8)$$

where m = the section modulus, and A = the area of one angle.

The stress on the extreme rivet of group G should also be investigated. The moment on this group of rivets =

$$\frac{S_1}{2} \times \frac{F}{2} + \frac{S_2}{2} \times \frac{F}{2} = \frac{(S_1 + S_2)F}{4} = M_3 \qquad (9)$$

The maximum vertical stress on rivet H due to rotation =

$$\frac{(S_1 + S_2)F}{4S.M.} = V_3 \qquad (10)$$

Vertical load per rivet =

$$\frac{\frac{S_2}{2} + WF - \frac{S_1}{2}}{N} = V_4 \qquad (11)$$

Horizontal stress on this group of rivets =

$$\frac{S_1F - \frac{WF^2}{2}}{h} = C_2 \qquad (12)$$

C_2 is also the total increment in compressive stress in this panel.
The horizontal stress per rivet =

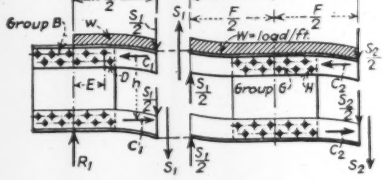
$$\frac{C_2}{N} = H_2 \qquad (13)$$

Resultant stress on rivet H =

$$\sqrt{(V_3 + V_4)^2 + H_2^2} \qquad (14)$$

The direct stress in the angles at this location = $C_1 + C_2$.

To illustrate the use of the above formulas, consider a girder on a span of 40 ft. center to center of supports and consisting of four 6x8x⅝ in. angles and 32x¾x2 ft. 6 in. web plates, spaced for



FORCES ACTING on a discontinuous-web girder.

a clear distance of 2 ft. 6 in. A uniform load of 2,000 lb. per ft. is assumed; the vertical distance, h, is taken to be 27 in.; and ten ¾-in. rivets spaced 3 in. apart longitudinally are used at each connection between the plates and angles. The area per angle is 8.36 sq.in., and the section modulus, m, 9.9 in.³

By substituting values in Eq. (1), S_1 was found to be 35,000 lb. From Eq. (2), V_1 is 2,250 lb.; Eq. (4) gives 10,600 lb. for V_2, and Eq. (5) gives 39,000 lb. for C_1, from which the horizontal stress per rivet = 3,900 lb. The resultant stress on rivet D was found to be 13,400 lb.

In order to find the maximum stress in the angles it is first necessary to determine the point of zero shear on them, which is not at the center of support as the rivets are not stressed evenly due to the moment they resist. The vertical stress on rivet D is 2,250 + 10,600 or 12,850 lb., while that on the rivet to the left of it was found to be 10,500 lb. As the sum of the stresses on these two rivets is 23,350 lb., the shear must pass through zero at the second rivet. The moment on the angles at this point was found to

be 335,000 in.-lb., so that the combined direct and bending stresses at this point =

$$\frac{335{,}000}{2\times 9.9}+\frac{39{,}000}{2\times 8.36}=19{,}200 \text{ lb. per sq. in.}$$

As found above, the resultant stress on rivet D was 13,400 lb. However, the stress on rivet H was found to be considerably greater in the following manner: S_2 is 25,000 lb.; $V_3 = 15{,}900$ lb.; $V_4 = 500$ lb., and $C_2 = 66{,}500$ lb., giving a horizontal stress on the rivets of group G of 6,650 lb. per rivet, showing a resultant stress on rivet H of 21,900 lb. This stress could be reduced by using more rivets placed closer together at each joint.

M. A. DRUCKER
Designer-in-Charge,
Board of Transportation.

New York, N. Y.
Sept. 22, 1936.

Depth of Sewage on Sand Filters

Sir: In your article on "Domestic Wastes Treated in Industrial Sewage Plants" in the October 8, 1936 issue of *ENR*, pages 506-7, it is stated that the sand filters of the disposal plant are covered with sewage to a depth of 1.138 ft. once every 14.2 hours. Using other data given in the article, I find that this figure is incorrect and should be 0.1315 ft., which is more nearly in accord with standard practice. This gives a dosage rate of about 80,000 gal. per acre per day—higher than that permitted in New York State, but less than that allowed in Rhode Island.

CLARENCE F. LAMB,
Waterman Engineering Co.

Providence, R. I.
Oct. 13, 1936

Stress in Concrete Beams

Sir—In your issue of Aug. 20, p. 281, Horner M. Hadley takes exception to Mr. Mensch's calculation of the compressive strength of concrete in reinforced beams by the assumption of parabolic distribution of fiber stress, (*ENR*, April 30, 1936, p. 641) arguing that a straight line distribution from the neutral plane is the generally accepted theory—hence established. While both theories are inexact Mr. Mensch would arrive at deflections more nearly in accord with observation or conversely closer to maximum compression.

When a reinforced concrete beam has become well cured and has been repeatedly loaded and unloaded (within proper working limits) the concrete attains nearly perfect elasticity. Nevertheless elastic deflections increase more rapidly than the load (as will be shown) in contrast to the beam of homogeneous material in which the deflections are proportional to the load. Also, while horizontal shears are equilibrated near mid-depth at the center of rotation of each elementary normal section in the beam of homogeneous material, in the composite concrete beam these shears are equilibrated at the steel near the bottom of the beam.

The locus of centers of rotation of elementary consecutive normal sections along the length of the beam is the so-called neutral axis. Because a center of rotation is a state of right shearing stress, the neutral axis of the composite as well as the homogeneous beam may be defined as the locus of consecutive states of righ shearing stress, i.e., characterized by equal intensities of tension, compression and shear.

With symmetrical distribution of horizontal shears above and below the neutral plane, the orientation of these states of right shearing stress is such that the greatest shears are parallel and normal to the neutral plane, hence the neutral plane of the homogeneous beam is unstrained along its length. In the reinforced concrete beam on the other hand, the greatest horizontal shears are equilibrated at the steel near the bottom, instead of at the centers of rotation, giving rise to unsymmetrical shear areas above and below the neutral plane and a rotation of the states of right shearing stress therein. This rotation is clockwise to the left and anti-clockwise to the right of that normal section which divides the moment area into halves. At that section horizontal shear and compression along the neutral plane are zero.

Hence there is no twist changing the orientation of the state of right shearing stress at the neutral plane (or center of rotation of this section) and the horizontal fiber compressions follow the linear law—zero at the neutral plane and a maximum at the top fiber. From this locus of zero rotation, the shift in orientation increases rapidly to a maximum of 22½ deg. accompanied by compression along the neutral plane and a lowering of the locus of zero horizontal compression below the centers of rotation. Because this rotation (necessary to equilibrate the unsymmetrical horizontal shears) increases the component of compression parallel to the neutral plane and reduces that of tension, the neutral plane of the concrete beam is compressed along its length. This elastic compression increases as the load, but as its lever arm is less than *jd* for the compressive fiber stresses *elastic deflections increase more rapidly than the loads.*

The hypothesis that internal shear strain is proportional to the external shearing force divided by the sectional areas is unnatural and highly erroneous. Thus the restrained beam may develop two or three times the resistance of the simply supported beam that may be loaded to end-shear failure, demonstrating the radical error embodied in rolling mill handbooks and building code rules today.

Hookes inexact hypothesis of the resistance of "springy bodies" still forms the unscientific basis of the mechanics of materials taught in engineering schools today. If a prism of elastic material be compressed lengthwise it is stretched or elongated sidewise. There is neither an external force nor any component of the applied force to account for this elongation. Under simple elongation the internal shearing stress (at 45 degrees) is calculated in standard texts as half the intensity of the unit force of elongation. The resultant of these shears presents a lengthwise component double the applied external force, indicative of an internal shift in the energy of molecular vibration double the external work, exactly as measured by Dr. Joule some 80 years ago. The value of Joule's work in thermo-elastic determinations failed of appreciation because he expressed his results in temperature change of the material under unit force. Had he reduced his energy values to inch pounds and coordinated the result with external mechanical work the significance of his investigation would have been appreciated by engineers and physicists as well.

The thermodynamic relations of external action to internal reaction may be stated as follows: Linear elongation is opposed by the cubic contraction of the decreased temperature resulting from a shift from kinetic to potential energy of molecular vibration. Linear compression is opposed by the cubic expansion of increased temperature resulting from a shift of potential to kinetic energy of molecular vibration. These thermo elastic temperature changes are subject to radiation affecting both strength and elongation.

The force of elongation (externally) is instantaneously equilibriated by a change in volume exactly proportional to the force and independent of radiation. Elongation increases and strength decreases until the radiation of the excess energy is complete. Thus a piece of structural steel (60,000 lb. ult.) will develop a yield point of 45,000 lb. under a pulling speed of 4 in. per min. and but 39,000 lb. under a speed of 0.1 in. per minute.

C. A. P. TURNER.

Columbus, Ohio.
Sept. 21, 1936.

No Tolls on Oregon Bridges

Sir—The program under which construction of the five Oregon coast highway bridges was planned provided for financing them with both grant and loan from the PWA; the loan was to be repaid from tolls. At last year's session of the Oregon state legislature, however, a bill was passed making the bridges toll-free. The original financing arrangement was revised so that it was necessary to take only a 30 per cent grant from the PWA; the remainder of the cost was met with state funds. Oregon state highway officials desire to encourage tourist traffic, which the toll-free bridges are expected to do. The article published in *Engineering News-Record*, Sept. 17, 1936, p. 421, was in error in referring to tolls as a means of financing.

R. H. BALDOCK
State Highway Engineer.

Salem, Oregon.
Sept. 24, 1936.

ENGINEERING NEWS-RECORD

Volume 117, No. 18

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October 29, 1936

Broadened Outlook

ENGINEERS as well as engineering educators will find food for thought in such remarks as those made by Louis Mitchell, dean of engineering at Syracuse University at an address before the recent public-works meeting at Toronto. He urged the need for breadth of view on the part of engineers in public service, and proper training to give this breadth of view. Our colleges, he charged, are not giving proper attention to this need; they place too much emphasis on specialized technical courses, to the neglect of the broader aspects of administrative leadership. In support of Dean Mitchell's position it may be said that present-day conditions of public-service engineering call for qualifications not believed essential heretofore. Greatly enlarged scope of the service has made public-works administration a professional vocation of large responsibilities, which demands men of corresponding breadth. When one finds that the civil engineering course at one college has had a consistent reduction in entrants for some years and now has only half as many students as in 1929 it appears that the young men themselves recognize that technical studies are not all, and that they will get their economics, business management and political science elsewhere if they cannot find them in their engineering courses. These subjects also are foundation studies, and the broadened outlook which they produce is needed most of all in the training of men for public-service administration.

Not Guilty

WHEN DISCUSSION of the engineering attitude is extended to the point of blaming science and technology for the world's present-day dislocations it is time for a fitting retort. Such retort was made by Karl T. Compton, head of Massachusetts Institute of Technology, in answering President Roosevelt's recent letter calling on the engineering colleges to equip their students for meeting their social responsibilities. The President charged that the impact of science and engineering upon human life has caused unemployment, bankruptcies and relief; he asserted that engineering in addition to creating tools of production must cooperate in designing "accommodating mechanisms to absorb the shock" of this impact; better balance of college curricula, he said, will enable coming generations of engineers to meet this responsibility. Dr. Compton rejects the indictment; he points to the great social advances that have been made possible by increased productive power and to the improved standards of life which we enjoy—all of them achievements of science and engineering. Moreover, he pointed out that these same arts are continually at work developing new products, new industries, new employment and improved health and welfare. Breadth of knowledge and outlook are no less needed among business leaders, economists and politicians than among engineers, Dr. Compton stated. Finally he urged that the government itself give more support to science and encourage its activities in government, industry and educational institutions. In brief, he restated effectively the known fact that science and technology have helped and not hurt the human race, that they constantly enlarge its productive performance with decrease of toil and open up to all a larger and more effective life.

Progress Toward Safety

CONSISTENT APPROACH to agreement on four-lane highway practice is a current indication of the fact that engineering study is gradually crystallizing the broad principles of highway safety. Until very recently the construction of roads carrying four lanes of traffic without physical separation was still considered sound and acceptable practice; today, few highway designers think it defensible to plan such wide arteries otherwise than as physically separated two-lane roads. The dangers that lie in placing opposing streams of dense, fast travel on a 40-ft. road have been so clearly demonstrated that center-line curbs or other barriers are being added on many existing four-lane roads to separate traffic. So far, however, only the general principle of separation has been agreed upon, and there continues to be difference of view on whether the separation should be wide or narrow. This point is perhaps not so much a matter of safety as of other considerations, for once a separation is made to eliminate conflict of traffic there is only moderate gain of safety by making the separation wider. Further study of divided road construction should lead to closer agreement, but the details are secondary to the fundamental decision that multi-lane roads must be so built as to separate opposing streams of traffic. This decision, now accepted virtually everywhere, stands out as a major safety gain.

Labor Shortage

SCATTERED BUT PERSISTENT reports of a shortage of experienced construction workers, already cited in this column, indicate an imminent dearth of skilled labor throughout the industry. Though the present shortage may not be alarming, the situation assumes serious proportions in view of the rising construction volume. The average age of skilled workers is rapidly approaching that of retirement, which in itself is sufficient warning of what is to come. Sharp decreases in construction work during the past four or five years is primarily responsible for the situation today; new men did not seek work in a field that offered no opportunity for employment, trades unions discontinued apprenticeship training, and many a skilled construction worker turned to other employment, never to return. WPA has been blamed for creating an artificial shortage of skilled workers, a charge which it denies. However, thousands of construction men are on the WPA rolls, some of whom are oldtimers while others have been trained on the job. These men should be transferred to private employment whenever this is available, and any WPA policies that stand in the way should quickly be adjusted to fit practical conditions. If present circumstances warrant temporary retention of relief status by men so graduated into self-sustaining jobs it should not be difficult to arrange. Immediate shortage of skilled labor can be met in this way. The much greater coming problem of shortage in skilled construction labor demands other measures. These call for the prompt and serious consideration of labor itself as well as of industrial commissions and contracting associations. Otherwise construction may soon find itself handicapped by want of labor at the very time when it is needed.

A Look Into the Future

THE EXCELLENT SYMPOSIUM on high-strength steels and light alloys which formed a part of the fall meeting program of the American Society of Civil Engineers at Pittsburgh two weeks ago served an admirable purpose in bringing back to earth a subject with which a good many liberties have been taken. Sudden success in the transportation field, where weight-saving is directly and simply translatable into money-saving, has led many to foresee a similar revolution in engineering structures. But visions, no matter how seemingly realistic, must not be confused with fact. Actually none of the new metals discussed, except the heat-treated aluminum alloys and they only to a limited extent, have seen structural service in this country. Thus, while the symposium provided a worthwhile look into the future it did not in any sense mirror a development that has already taken place.

Particular interest, of course, centers on the new low-alloy steels, partly because their counterparts are being used in some European structures and partly because of our familiarity with nickel and silicon structural steels and their advantages. This same familiarity, however, counsels caution with these new steels, in view of the special problems that the common alloy steels have presented and still present. Alloy-steel members are universally smaller in cross-section than mild-steel members of comparable strength. Small members show greater proportional deformation; they develop vibrations of greater intensity; they are more prone to buckling failure. Their higher yield-point permits a higher working stress for static loads, but has much less meaning, perhaps even an opposite meaning, with respect to distortions inseparable from working and handling and to shock and frequent stress reversal. These latter demand toughness, resilience and endurance, all of which are promoted by a high ratio of ultimate to yield strength.

These are problems which already face the designer of a structure using the familiar silicon or nickel steels. When yield-points are further raised by 20 to 30 per cent, as in the new alloy steels, the complexity of the problem increases in proportion. Furthermore, when the spread between yield-point and ultimate is drastically reduced, which is to say the ratio of ultimate to yield strength, engineers necessarily will hesitate to adopt such steels until more data and experience are available. Several engineers expressed this hesitancy at the recent meeting.

If stronger steels are to be used, they must exhibit their economic advantage through lighter, thinner members. Factors of safety must be reduced, or (to express the situation more correctly) factors of safety must be more exactly determined. Design refinement is mandatory. Stress-concentration effects, corrosion loss, fatigue strength and perhaps even creep phenomena, now covered in high factors of safety, will need to be taken into account. Idealized designing that serves well enough for a cheap but sturdy material will have to be replaced by procedures that more nearly evaluate actual conditions when a high-cost and perhaps high-strung material is used.

The look into the future that the symposium offered is a promising one; but, more significant than that, it also offers a challenge to the design abilities of the engineer. Before the great theoretical economies can be secured, before the vision of greater structures to come can be made real, design must be transformed into more of a science. In the meantime knowledge of the new metals, both in the laboratory and in the field, must be enlarged beyond anything heretofore thought necessary in respect to metals now common. Then and only then will the revolution in design be ready to take shape in the structural field.

One more thing the symposium made plain: These new metals or some better ones are eventually going to make a place for themselves in the structural field in spite of the difficulties now apparent. Structural engineers will best serve themselves and the profession by taking seriously the challenge that the present look into the future throws up to them.

Public Leadership

SELECTION OF H. E. JORDAN to the position of directing executive of the American Water Works Association is an event whose influence extends beyond the ranks of that society. In building up, as it promises to do, a more effective central organization in the water field it will strengthen the position of those who are responsible for our technical public services and will give the engineer and the technical society a larger place in public affairs.

The waterworks field has special need for vigorous and wise leadership. Surrounded as it is by other utility services that in the main are privately operated, yet itself largely in municipal hands, public water service is ever exposed to invidious comparison with private business, while all too often it suffers from the handicap of interfering or exploitational political control. Caught between two fires, it needs the support of an aggressive and competent national organization both to promote the development of the art and to aid in maintaining a competent, stable operating personnel.

It is the duty of such a body to see that the water service is staffed with men who will put the results of modern research to work and will protect the vital interest of the public in its water supply while carrying the service daily to higher levels. Its field includes the study of improved management, organization, public relations and finances as well as chemistry, hydraulics and the technique of filters and pumps. To this task Harry Jordan, a leader in the practical application of research at Indianapolis, brings the combined abilities of expert technician, practical operator and organizer. With the gift of enlisting the enthusiastic cooperation of others, an invaluable asset in society work, he can hardly fail to guide the association onward to a position commensurate with its high responsibility.

Strong leadership is vital to our technical and operating societies. Experience has shown that group action for progress is fully effective only in those organizations whose directing councils and executives are animated by vision and aggressiveness. And it has also shown that whatever one society gains in this way is helpful to others, strengthening them by the stimulus which it exerts and by the greater recognition of technical performance which it brings about. It is in this sense that the new leadership of the American Water Works Association is of more than local interest. It holds out promise that by building greater organized strength in the field of water service and engineering it will exert a constructive influence to the benefit of the profession as a whole.

CURRENT NEWS

New PWA Fund One Third Allotted

Grants emphasize power production and transmission—irrigation and flood control also covered

THREE sets of PWA allotments, made on Oct. 22, 23, and 26, bring the allotments from the third PWA fund to about one-third of the $300,000,000 limit. The new allotments cover grants of $22,089,000 and loans of $3,906,000 on 319 projects with an estimated construction cost of about $49,115,000.

The largest allotment was a grant of $1,041,000 and a loan of $1,273,000 to the Loup River Power District, Columbus, Nebr., to provide for the distribution of power generated at two stations provided for by a previous allotment. The new money will cover the construction of 164 miles of 115,000 volt transmission line, 50 miles of 66,000 volt lines convertible to the higher voltage, and six substations. These facilities permit the distribution of energy to a number of Nebraska cities and rural electrification projects. This part of the transmission system is not affected by the pending suit against PWA and the local sponsors filed by the Iowa-Nebraska Light & Power Co.

Other allotments for power purposes include a grant of $76,000 to the city of Flandreau, S. D., for a diesel generating station and distribution system; a grant of $36,000 to Nelsonville, Ohio; and grants totaling $755,495 with loans amounting to $364,000 to six publicly owned power projects in Missouri, Nebraska, Nevada, North Carolina, Tennessee, and Virginia.

Irrigation and flood control projects in the drought area received a number of allotments, of which the largest was a grant of $515,454 and loan of $630,000 to the Montana state water conservation board for the construction of a rockfill dam with a steel face on the Beaverhead River. This dam, with a crest length of 1500 ft. and a maximum height of 80 ft., will impound 81,000 acre-ft. for irrigation purposes.

Among the larger grants for bridge and building construction were a grant of $643,000 to the city of Troy, N. Y., for a school building; a grant of $420,000 to Chicago, Ill., for a viaduct; and a grant of $579,400 for a highway and three connecting bridges to Allegheny County, Pa.

Contract Awarded For Oakland Tunnel

Contract for completion of the Broadway low-level highway tunnel at Oakland, Cal., was awarded by highway district No. 13 to the George Pollock Co. of Sacramento and R. G. Clifford of San Francisco on their joint bid of $731,000. The contract calls for completing the driving of the tunnel the remaining distance of 1,408 ft. and lining 1,671 ft. of arch rings. This lining contract does not include the ceiling nor any concrete in the invert, which will be let under a separate schedule. Two other bids were received when the bids were opened on Oct. 16.

Work on this tunnel was abandoned on June 13 by the original contractor, Six Companies of California. A first call for bids, to be opened Sept. 11, did not produce any bidders. (*ENR*, Sept. 24, 1936, p. 457).

TVA Makes New Effort To Halt Nashville Suit

TVA began a new attempt, on Oct. 23, to secure dismissal of the suit brought against it in the Nashville federal court by nineteen Tennessee Valley utility companies. The government presented a motion asking that the action be dismissed on the grounds that the current suit embodies no issues not raised in the Ashwander case decided by the United States Supreme Court last February. The motion was taken under consideration by Judge Gore of the U. S. District Court at Nashville.

On the same date the Georgia Power Co. filed a petition at Marietta, Ga., asking that the North Georgia Electric Membership Corp., a rural electrification cooperative, be restrained from conducting a public utility business in northwestern Georgia. This cooperative was formed to purchase and resell TVA power by means of a rural network, the construction of which has been financed by a $370,000 REA allotment.

Three Bids Received For Marshall Ford Dam

The low bid for the construction of Marshall Ford Dam on the Colorado River, 23 miles northwest of Austin, Texas, was $5,781,000, submitted jointly by Brown & Root, Inc., of Austin and the McKenzie Construction Co. of San Antonio. The bids on this project, which is the second of three dams to be constructed on the Colorado River between Austin and Llano as a part of the Lower Colorado River Authority flood control project, were opened at Austin on Oct. 20 by the United States Reclamation Bureau. (*ENR*, July 2, 1936, p. 27). Two other bids were offered, one by the Utah Construction Co. of Salt Lake City for $5,909,000 and the other by W. E. Callahan Construction Co. of Dallas for $7,322,000. All three bids will be forwarded to Washington for consideration before the contract is let.

The dam, which will impound 1,500,000 acre-ft. of water, will be 180 ft. high and 4,000 ft. long. A hydroelectric plant will be constructed at the dam.

President Suggests Balanced Training

Roosevelt asks engineering teachers if engineers are meeting social responsibilies—Compton of M.I.T. replies

PRESIDENT ROOSEVELT has addressed a letter to the heads of more than 100 schools and colleges throughout the country asking whether "the curricula of engineering schools are so balanced as to give coming generations of engineers the vision and flexible technical capacity necessary to meet the full range of engineering responsibility."

The President's letter was sent with copies of "Little Waters," a recent conservation pamphlet. The letter follows in part:

> "Events of recent years have brought into clearer perspective the social responsibility of engineering.
>
> "In respect of wise use of natural resources such reports as those of the Mississippi Valley Committee, the National Resources Committee, and the Great Plains Drought Area Committee, have brought out the fact impressively. The enclosed report, 'Little Waters,' presents in miniature many of the social engineering problems of soil and water conservation.
>
> "In respect of the impact of science and engineering upon human life—social and economic dislocations as well as advance in productive powers—the facts are revealed with distressing clearness in public records of unemployment, bankruptcies, and relief.
>
> "The design and construction of specific civil engineering works or of instruments for production represent only one part of the responsibility of engineering. It must also consider social processes and problems and modes of more perfect adjustment to environment, and must cooperate in designing accommodating mechanisms to absorb the shocks of the impact of science.
>
> "This raises the question whether the curricula of engineering schools are so balanced as to give coming generations of engineers the vision and flexible technical capacity necessary to meet the full range of engineering responsibility.
>
> "I am calling this matter to the attention of educators of high administrative authority in the hope that it may be thoroughly explored in faculty discussion and in meetings of engineering, educational and other pertinent professional associations."

Dr. Earl T. Compton, president of the Massachusetts Institute of Technology, replied to the President's letter, expressing surprise that the "exhortation had been directed specifically toward engineers" and stating that "similar breadth of knowledge and training is also urgently desirable among business leaders, economists and politicians." Dr. Compton stated that the considerations mentioned in the President's letter are already matters of concern to progressive educators and engineers. He said, however, that in his opinion the application of science was responsible for such great improvements in the general standard of living as to "dwarf into insignificance the social and economic dislocations" to which the President referred.

Dr. Compton asserted that the contribution which science and engineering could make to the improvement of society lay not in paliative measures for the solution of immediate problems but rather in research

which, by the development of new processes and industries, would increase the productive power of the nation.

Dr. Compton's letter follows in part:

"In response to your challenge to educators . . . I am sure you will be pleased to know that these are already matters to which progressive educators and engineers have been giving attention . . . Increasing emphasis is being placed upon fundamentals rather than specialties in undergraduate engineering education, and there has been a notable increase in attention to the study of economic and social science.

"I cannot but wonder why your exhortation has been directed specifically toward engineers, for surely you would agree that similar breadth of knowledge and training is also urgently desirable among business leaders, economists and politicians, as is also a thorough training in fundamentals.

"Science and engineering have so increased productive power that it has been possible for enlightened public leaders to inaugurate a great program of social security . . . such achievements of science dwarf into insignificance the social and economic dislocations to which you refer.

"There are two basic methods of dealing with unemployment, bankruptcies and other similar dislocations which you mention, one paliative and the other curative. Both may be needed.

"The former includes relief and operates immediately; the latter aims at creation of new values, and is a longer range program.

"It is primarily to the latter that engineers and scientists are devoting their major attention . . . quite properly and of necessity it is the first method which has been the chief concern of the government.

"Engineers and scientists, however, are disturbed lest the paliative measures be mistaken for the cure, and lest the attention and money devoted to relief and regulation should interfere with simultaneous adequate attention and support to the basic contribution which our scientists can certainly make if given a chance.

"Your letter to us calls attention of the public to the dislocations produced by science and quite properly calls on us to try to cure them, but it does not indicate interest in the creative work and permanent values which engineers and scientists continue to regard as their chief contribution to social welfare."

Resistance Made to Walsh-Healey Act

Washington Correspondence

THE FIRST evidence of resistance to the new Walsh-Healey government contract act became evident Oct. 19 with the opening of bids for twelve light trucks to be used by the Resettlement Administration. Of the four bidders for the truck order, only one, the A. J. Corbitt Company, a small manufacturer, agreed to the Walsh-Healey stipulation by submitting a total bid of $18,315. The other three, General Motors Truck Co., International, and Reo, dropped below the $10,000 limit established in the act by submitting partial bids for seven, eight, and eight units, respectively, rather than for the full number. Figured on a unit basis the Corbitt bid was high, but it was the only one for the entire contract.

On Oct 24 the Procurement Division of the Treasury rejected all the bids and readvertised the contract. The same course of action was taken on a second contract for sixteen trucks, also for the Resettlement Administration, upon which bids had been opened a few days later. Here, again, the only bidder who agreed to the Walsh-Healey stipulations was the Corbitt Co.

The new call for bids, which will be opened on Nov. 2, includes, in addition to the Walsh-Healey provisions, the stipulation that the award will be made on an "all or none" basis. It is expected that the result will be a drop in the number of manufacturers bidding and a possible increase in the number of dealers represented. Under the provisions of the law, as interpreted by the Secretary of Labor, a successful bidder in the dealer classification may obtain his materials and equipment for fulfilling the contract without regard to the Walsh-Healey restrictions, except as regards his own employees.

The first attempt to obtain exemptions from the provisions of the law was made by the Cotton Textile Institute. The Institute, claiming that the cotton cloth industry as now organized cannot comply with the requirements of the act, asked permission to reduce the 18-year age limit established in the act for female labor, to 16 years, and to extend the 40-hour week in the case of operations forming part of a continuous process where abrupt stoppage would result in losses to goods in process.

Sewage Filters Awarded For Twin Cities Plant

Award of a $500,000 contract for the construction of eight rectangular-magnetite sewage filters, each 16 ft. wide and 245 ft. long, to the Filtration Equipment Corp., has been made by the Minneapolis-St. Paul Sanitary District. This installation, with a filtering area about twice as large as a similar type now under construction at Denver, Colo. (ENR, Oct. 15, 1936, pp. 535-39), will be employed to treat settled sewage at the new Twin Cities disposal plant. The capacity of the plant will be adequate for an average flow of 134 m.g.d., and it has been designed to provide chemical treatment during periods of low river stages or whenever a higher degree of purification is required. Details concerning the general design of the Minneapolis-St. Paul project were published in ENR, April 9, 1936, pp. 527-30.

TRANSPORTATION FOR 160,000 PERSONS PER HOUR PLANNED FOR NEW YORK FAIR

The above drawing of the central area of the 1939 New York World's Fair shows the network of highway and intramural roads which will handle a peak load of 160,000 persons per hour, according to estimates made by engineers of the fair corporation. This estimate is based on the capacity of the various transportation facilities serving the fair. Thus, it is estimated that the I.R.T.-B.M.T. subway line, along Roosevelt Ave. will be able to deliver 40,000 passengers an hour to the fair. The Port Washington branch of the Long Island Railroad, which borders the fair, is counted on for 18,000 an hour. It is estimated that 40,000 persons an hour can use the Independent subway, which enters at the north end of the amusement section. Trolley lines and buses on Harding Boulevard will bring in 15,000 an hour. Some 10,000 visitors an hour can enter in buses and automobiles by the north parking area and an equal number from the south parking area. Two bus and taxi stations on the west side will handle 10,000 passengers each, while on the opposite side, buses and automobiles will deposit 5,000 passengers an hour.

These crowds will be handled by an intramural bus system which will include express buses circling the circumference of the fair ground and local buses on the inside roads. Numerous underpasses and overpasses will prevent conflict between pedestrian and vehicle traffic.

In the above view Harding Boulevard can be seen cutting through the righthand side of the central area, crossing Grand Central Parkway Extension at the clover leaf in the lower right.

Contract for designing the administration building at the fair ground has just been awarded to Allied Architects, a syndicate of four firms. Construction on this building will start late in December, with completion scheduled for late August, 1938. The structure will occupy 57,000 sq.ft. of ground and will be two stories in height. It will be so located as to permit access from outside the fair grounds, and will give directly into the grounds by way of a bridge and pay gates. It will be a steel frame building with stucco exterior finish and sheet rock interior finish.

The firms associated in allied architects are: Eastman Studds and Harry Stevenson; John A. Thompson and Gerald A. Holmes; Edgar I. Williams; and Ellery F. Husted, and Richard Kimball.

E.C.P.D. Accredits Engineering Curricula

Engineers council releases list of approved curricula in New England and Middle Atlantic colleges

THE ENGINEERS Council for Professional Development has approved the curricula offered in a variety of engineering subjects by colleges in the New England and Middle Atlantic States. The committee on engineering schools, which has been acting for the council in making investigations and reports on which the accrediting is based, has so far confined its work to these two areas. Investigations were made only in colleges which so requested, and the list may, therefore, even in the areas covered, be added to in the future.

Curricula in schools in the United States not included in the New England and Middle Atlantic areas will be investigated during the coming year by the committee on engineering schools, and a complete list of accredited curricula will be issued and approved by the council.

Accrediting was made on the basis of individual curricula rather than of colleges. The entire council considered every curriculum separately and based its decision on reports made by a number of groups of engineers and educators who visited the colleges under the direction of the council's committee on engineering schools, of which Karl T. Compton, president, Massachusetts Institute of Technology, is chairman.

The decision of the council was based on the following qualitative considerations: (1) The qualifications, experience, intellectual interests and attainments, and professional productivity of members of the faculty. (2) The standards and quality of instruction in the engineering department and in the scientific and other cooperating departments in which engineering students receive instruction. (3) The scholastic work of the students. (4) The records of graduates in graduate study and in practice. (5) The attitude and policy of the administration toward the engineering division and toward teaching, research and scholarly production.

Certain quantitative considerations were also taken into account: the control and organization of the college and of the engineering division; the curricula offered and the degrees conferred; the age of the institution and of the individual curriculum under consideration; the requirements for admission of students; the number of students enrolled in the engineering college and in the individual courses; the admission requirements; the size of the teaching staff and the teaching loads; the physical facilities available; and the finances of the institution.

At this time, only undergraduate courses leading to degrees have been accredited. In certain cases both day and night sessions have been accredited, but in general action has been deferred on evening sessions. In the following list of approved curricula, those institutions in which both day and evening sessions have been approved are indicated by the symbol (a). The list is not complete as to branches of engineering.

APPROVED CURRICULA

Architectural Engineering
Massachusetts Institute of Technology
Pennsylvania State College

Civil Engineering
Brown University
Carnegie Institute of Technology (a)
Clarkson College of Technology
College of the City of New York (a)
Columbia University
Cooper Union Institute of Technology
Cornell University
Dartmouth College
University of Delaware
Drexel Institute
Johns Hopkins University
Lafayette College
University of Maine
Massachusetts Institute of Technology
University of New Hampshire
New York University
Newark College of Engineering
Norwich University
Pennsylvania State College
University of Pittsburgh
Polytechnic Institute of Brooklyn (a)
Princeton University
Rensselaer Polytechnic Institute
Rhode Island State College
Rutgers University
Swarthmore College
Syracuse University
Tufts College Engineering School
Union College
University of Vermont
Worcester Polytechnic Institute
Yale University

Electrochemical Engineering
Massachusetts Institute of Technology
Pennsylvania State College

Mining Engineering
Columbia University
Lafayette College
Massachusetts Institute of Technology
University of Pittsburgh

General Engineering
University of Maine
Massachusetts Institute of Technology
Stevens Institute of Technology

Sanitary Engineering
Massachusetts Institute of Technology
Pennsylvania State College
Rutgers University

SOCIETY CALENDAR

INTERNATIONAL ACETYLENE ASSOCIATION, annual convention, St. Louis, Mo. Nov. 18-20.

ASSOCIATED GENERAL CONTRACTORS, fall meeting of governing board, Washington, D. C., November 16-17.

HIGHWAY RESEARCH BOARD of the NATIONAL RESEARCH COUNCIL, annual meeting, Washington, D. C., Nov. 18-20.

AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS, annual meeting, San Francisco, Calif., December 7-10.

ASSOCIATION OF WESTERN STATE ENGINEERS, annual meeting, Santa Fe, N. M., Dec. 3-5.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION, MIDDLE ATLANTIC SECTION, fall meeting, New York City, Dec. 5.

LICENSE EXAMINATIONS

NEW YORK STATE, examination for professional engineers and surveyors, Jan. 25-27, at Albany, Buffalo, New York City and Syracuse. Applications must be filed with the State Education Department at Albany before Nov. 1.

Officers elected at a meeting, held Oct. 15 at Fort Smith, Ark., of the SOUTHWEST SECTION of the AMERICAN WATER WORKS ASSOCIATION, were as follows: Chairman, Henry E. Nunn, VanBuren, Ark.; vice-chairman, Thomas L. Amiss, Shreveport, La.; Arkansas trustee, Lloyd Rebsamen, Jonesboro; Louisiana trustee, R. H. Brooks, Ruston; Oklahoma trustee, L. F. Scott, Oklahoma City; Texas trustee, A. M. Brenneke, Denison.

Newly elected officers of the TOLEDO SOCIETY OF PROFESSIONAL ENGINEERS are: President, G. Warren Emery; vice-president, R. M. Batch; secretary-treasurer, A. S. Forester.

Goodman Becomes Commissioner Of N. Y. Water Department

Joseph Goodman, chief engineer and acting commissioner of the department of Water Supply, Gas and Electricity, was made commissioner of that department on Oct. 27, succeeding the late Thomas W. Hammond. In making the appointment Mayor F. H. LaGuardia emphasized the importance of encouraging career possibilities in the field of public service, and announced that he would seek to place the office of commissioner under civil service status. Mr. Goodman has been a civil service employee in the department for 36 years.

Step-up promotions for 18 members of Mr. Goodman's engineering staff were made possible by the elevation of the chief engineer to the post of commissioner. The list of those advanced includes: Assistant engineers, H. B. Machen, W. D. Hubbard, J. P. Lonergan, F. B. Nelson, M. F. Quinn, H. B. Hollander, M. A. Weisman, L. F. Searle, Harry Taylor; mechanical engineer, William Flannery; topographical draftsmen, F. X. Elder, B. Feitelson; J. J. Simpson, Howard Fincke; transitman, A. D. Henderson; engineering assistants, Lawrence Coonan, Morris Becker.

Engineering Examiners Meet

Twenty-five state boards of examiners and seven national engineering groups were represented at the seventeenth annual meeting of the National Council of State Boards of Engineering Examiners, held on Oct. 19-21 in Knoxville, Tenn.

The annual report of the secretary indicated that the membership of the National Council now consists of 35 state boards of examiners. Four state boards have joined the council since the last meeting—Maine, Nevada, Washington, and Alabama. No new registration laws have been passed during the past year. A registration bill was introduced in the Kentucky legislature, but it was defeated. The report indicated, however, that registration bills would be presented to the 1937 sessions of the legislatures in Missouri, Delaware, and Nebraska.

The report of the Committee on Professional Recognition of the Engineers Council for Professional Development was approved by the National Council and a resolution was passed urging the E.C.P.D. to adopt that report.

The following officers were elected for the coming year: President, Prof. J. S. Dodds, Ames, Iowa; vice-president, Prof. S. H. Graf, Corvallis, Ore.; director of the western zone, K. C. Wright, Salt Lake City, Utah; director of southern zone, Prof. C. L. Mann, Raleigh, N. C.; director of central zone, Dean R. A. Seaton, Manhattan, Kans.; director of northeast zone, C. G. Massie, Lynchburg, Va., and executive secretary, T. Keith Legare, Columbia, S. C.

The chairmen of the standing committees are as follows: accredited engineering schools, Dean P. H. Daggett, uniform examinations for registration, C. T. Olmsted; legal procedure, C. C. Knipmeyer; constitution, S. H. Graf; National Bureau of Engineering Registration, Ralph J. Reed, and Engineers Council for Professional Development, Dr. D. B. Steinman.

Steel Fabricators Hold Annual Meeting

FOR THE 14th time since its establishment in 1923, the American Institute of Steel Construction met in annual convention last week. The meeting was held in White Sulphur Springs, W. Va., to consider the problems and weigh the accomplishments of the Institute. Representatives of a large proportion of its 157 member steel fabricating companies were present to listen to reports by C. G. Conley (Mount Vernon Bridge Co.), president; and by Robert T. Brooks, executive vice-president; V. G. Iden, secretary; Robert E. Post (Post & McCord), treasurer; F. H. Frankland, chief engineer; and T. H. Hendrix, director of statistics. Other speakers included Charles F. Goodrich (American Bridge Co.) whose talk on the San Francisco-Oakland Bridge was followed by the first showing of a sound moving picture of the construction operations; J. R. Burkey (Ohio State Highway Department), who spoke on the Ohio bridge program; A. C. Greensfelder (Fruin-Colnon Contracting Co.), whose subject was "Let's Rebuild America," and Thomas F. Holden (F. W. Dodge Corp.), who discussed prospects in the building industry.

Bookings of structural steel during the first eight months of 1936 were 1,034,000 tons, 55 per cent of the 1928-31 average which the Institute considers normal. The tonnage of fabricated structural steel sold this year represents an increase of 50 per cent over last year. Commenting on future prospects, Mr. Iden stated his belief that the cessation of relief expenditures by the federal government would not seriously curtail business, since these expenditures do not exceed 6 per cent of the total national income distributed. During the year the Institute lost seven members due to the inauguration of a new policy in which active membership was placed upon a strictly dues paying basis. However, an increase in dues from 15 to 20 cents per ton resulted in an increase in revenue from $127,500 in 1935 to $186,300 in the current year.

Mr. Hendrix reported, in an analysis of the type of work represented in this year's bookings, that 58 per cent was for public or government work. Of this, 40 per cent was for bridges and grade crossing elimination, while the remaining 18 per cent represented public buildings and such projects as locks and dams, irrigation works, etc. Industrial and commercial buildings took 33 per cent of the total; 4 per cent went into private institutional projects such as colleges, schools and hospitals; and 5 per cent went into railroad work.

The Institute has kept up its support of research work, according to Mr. Frankland, who itemized projects at the Bureau of Standards covering stress distribution in and around the knees of rigid frames; at Lehigh University on the stress behavior of the complete rigid frame; at Columbia University on the failure of thin plates such as are used in derricks and other erection equipment; and at Swarthmore College on plate girders, to determine their moment of inertia and the stress behavior of their various parts. During the year the Institute issued a new specification for the design, fabrication, and erection of structural steel for buildings; the outstanding change was an increase in the basic unit stress from 18,000 to 20,000 lb. per sq.in. V. E. Ellstrom (Bethlehem Steel Co.) reported that a new edition of the Institute's Manual, planned for about May 1 of next year, will include all of the changes made necessary by the new specification.

All of the present officers of the Institute were re-elected for the coming year.

Jordan Accepts Post As Secretary of A. W. W. A.

Harry E. Jordan, chemical engineer of the Indianapolis Water Co., and former president of the American Water Works Association, has accepted the appointment of secretary to the association, a post that has been vacant since May 1 when Beekman C. Little retired from active duty. The appointment is to become effective on Dec. 1.

Mr. Jordan has been identified with the association since the formation of the Indiana Section in 1908, and has taken an active part in both the technical and administrative functions of the national organization, which comprises 21 regional and state sections in the United States and Canada. He was chairman of the water purification division of the association in 1923, and its secretary from 1925 to 1934, when he became president of the association. As a member of the advisory committee to the Secretary of the Treasury he assisted in formulating the U. S. Standards for drinking water in 1925. In 1936 he received the Diven medal which is awarded annually to the member of the association whose activities are considered of greatest value to the water-works profession.

After graduation from Franklin College, Ind., in 1903, Mr. Jordan joined the staff of the Indianapolis Water Co., as chemist. Since 1911 he has been in charge of the purification plant, except for a short period during the world war when he served as utility officer and construction quartermaster at Camp Sevier, Greenville, S. C. P. S. Wilson who has been acting secretary will assume the duties of technical secretary, the position for which he was originally chosen to replace A. W. Ruggles.

Panama Abolishes Road Board

The Central Road Board of Panama was abolished by presidential decree on Oct. 25 and its functions were transferred to the Ministry of Public Works. This action ended the services of Chief Engineer Thomas Guardia, who has long been in charge of Panama's road building.

Mr. Guardia is chairman of the Inter-American Highway Commission. Under his administration Panama's section of the highway has been nearly completed.

Public Health Association Meets in New Orleans

One day of the annual meeting of the American Public Health Association, held at New Orleans Oct. 20-23, was devoted to public health engineering. Federal and local governmental activities looking toward control of water pollution were discussed, as were various aspects of water and sewage treatment. The protection of shellfish beds from pollution received attention. Plumbing and chlorination were also discussed.

The following officers were elected in the public health engineering section for the coming year: Chairman, Prof. Gordon M. Fair; vice chairman, Joel I. Connolly; secretary, Roy J. Morton; council member, Arthur P. Miller; committee on fellowship and membership, Morris M. Cohen; member of association nominating committee, Arthur D. Weston.

Blasting for New Sewer Breaks Buffalo Water Main

A small flood occurred and many large industrial plants were shut down for about an hour when one of the seven 48-in. feeders leading from the Ward pumping station in Buffalo, N. Y., broke on Oct. 20. The break was attributed by Alan Drake, water director, to blasting being done in the bed of the old Erie Canal in connection with the sewer construction program now under way in Buffalo.

Damage from the flooding caused by the break is not expected to be great. Normal pressure was restored, by rerouting the water, about an hour after the break, but it will not be possible to repair the broken main for about a week, due to the necessity for sending away for materials.

Obituary

LEE D. MILLER, deputy commissioner of the New York City department of hospitals in charge of the architectural and engineering branches, died at Croton-on-Hudson, N. Y., at the age of 44. Mr. Miller studied architecture at the University of

Pennsylvania, engineering at Columbia, and law at New York University.

GEORGE H. WILLIAMSON, 64, chief supervising architect for the Federal Housing Administration in Colorado, died on Oct. 11.

ARCHIBALD MCGILLIVRAY, deputy minister of public works and highway commissioner of Manitoba, died on Oct. 14 at the age of 62. Mr. McGillivray had been in the provincial service for 32 years.

FRANK H. NEFF, 71, who before his retirement was head of the civil engineering department at Case School of Applied Science in Cleveland, Ohio, died on Oct. 19 in South Euclid, Ohio.

HENRY M. EAKIN, 53, head of the section of hydrodynamic studies in the federal Soil Conservation Service, died in Washington, D. C., on Oct. 20. Mr. Eakin had served in the Alaskan branch of the Geological Survey and as senior scientist on special investigations on sedimentation and river hydraulics under the Mississippi River Commission.

J. J. BOYNTON, 75, who served as civil engineer on construction of the first railroad from Atlanta to Warm Springs, Ga., died in Bartow, Fla., on Oct. 17.

CONSTRUCTION STATISTICS FOR THE WEEK

ENGINEERING construction awards for the week total $44,849,000 of which private is $16,163,000; public, $28,686,000, federal $3,696,000, and state and municipal, $24,990,000. Corresponding values for a year ago are: total, $28,329,000; private, $8,768,000; public, $19,561,000; federal, $4,250,000; state and municipal, $15,311,000.

Sewerage awards, industrial buildings, commercial buildings and unclassified are higher for the week. The classified totals are: industrial buildings, $5,429,000; commercial buildings, $4,977,000; public buildings, $5,618,000; highways, $10,989,000; bridges, $2,088,000; sewerage, $3,616,000; waterworks, $714,000; earthwork, drainage, $1,364,000; unclassified, $10,054,000.

The larger awards for the week include: beer fermenting plant, Anheuser-Busch, Inc., St. Louis, Mo., est. $750,000; steel plant units, Tennessee Coal, Iron and Railroad Co., Birmingham, Ala., $2,000,000; law school, Louisiana State University, Baton Rouge, La., $679,000; completion of administration building, City Council and San Diego County, San Diego, Calif., $627,000; garage, 50th Street and 12th Avenue, for Department of Sanitation, New York, N. Y., $658,000; gymnasium, U. S. Military Academy, West Point, N. Y., $735,000; highways, New Mexico, $518,000; Iowa, $649,000; Ohio, $1,443,000; Indiana, $1,744,000; mechanical equipment, Contract N, Section 4, Wards Island Sewage Disposal Plant, New York, N. Y., $650,000; superstructure, Wards Island Sewage Treatment Plant, New York, N. Y., $1,675,000; Boca Dam, Truckee Storage Project, Nevada-California, Boca, Calif., $729,000; subway WPA labor, Boston, Mass., $1,715,000; completion Broadway-Low Level Tunnel, Directors Joint Highway District No. 13, Oakland, Calif., $731,000; shed enclosure, Pier 92, West 52nd St., New York, N. Y., $567,000; 3,000 tons steel rails, Southern Railway, Richmond, Va., est. $950,000; track and road improvements, day labor and separate contracts, Western Pacific Railroad, California, Nevada, Utah, $2,600,000; steel rails, Southern Pacific Railroad, San Francisco, Calif., est. $1,200,000.

New capital for the week includes PWA allotments of $8,863,000, state and municipal bond sales of $6,243,000, plus purchases of PWA bonds from RFC, $4,695,000, and corporate, $5,779,000.

CONTRACTS
(Thousands of Dollars)

	Weekly Average Oct. 1935	Prev. 4 Weeks	Week Oct. 29 1936
Federal Government	$6,563	$4,483	$3,696
State and Municipal	17,907	24,469	24,990
Total public	$24,470	$28,952	$28,686
Total private	12,056	14,871	16,163
Week's total	$36,526	$43,823	$44,849
Cumulative to date:			
1935	$1,199,672,000	1936	$1,957,801,000

NEW PRODUCTIVE CAPITAL
(Thousands of Dollars)

1936	Week Oct. 29	Cumulative
State and municipal	$10,938†	$428,938†
PWA non-federal	4,168†	219,396†
RFC loans	....	26,663
Corporate issues	5,779	210,138
PWA loans, Private	....	—1,665*
Total Non-Federal	$20,885	$783,470
Federal	....	691,237
Total new capital	$20,885	$1,474,707
Cumulative to date:		
1935	$2,428,179,000	1936	$1,474,707,000

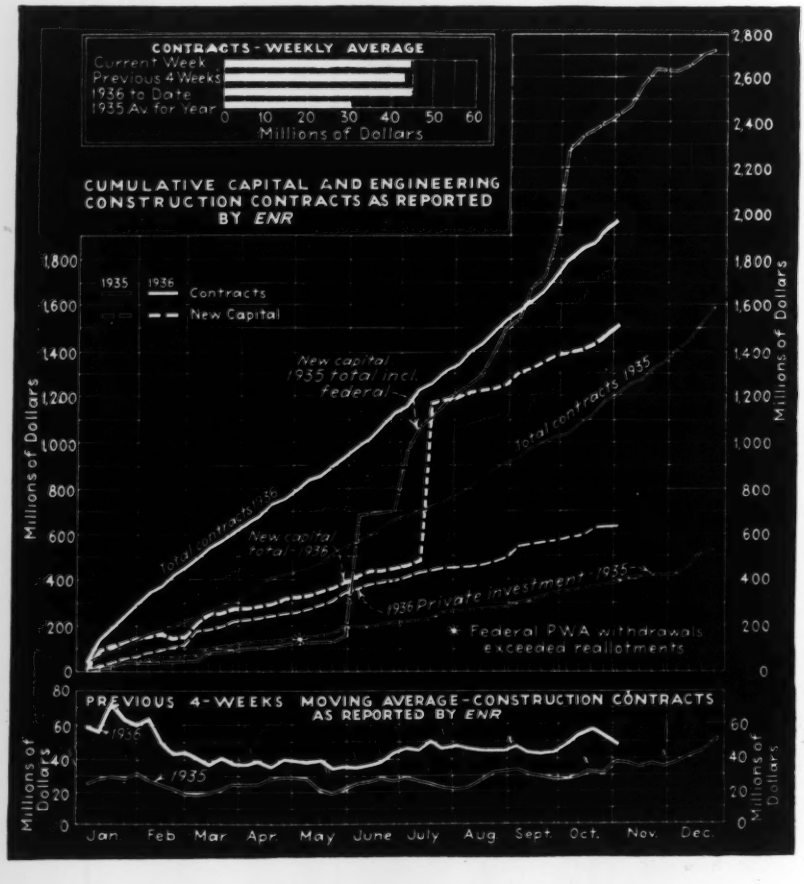
* Bond sales in this classification exceed reallotments during current year.

† Includes transfer from federal to private investment financing through sale by RFC of PWA bonds.

Note: These figures include private bonds, and stocks sold for productive purposes; state and municipal bonds for construction; PWA loans and grants to states and municipalities. RFC direct purchase of bonds for "self liquidating" projects, and 25 per cent of WPA construction appropriations.

INDEX NUMBER

ENR	1913	1926	ENR	1913	1926
Cost	= 100	= 100	Volume	= 100	= 100
Oct., 1936	211.50	101.67	Sept., 1936	200	88
Sept., 1936	208.10	100.08	Aug., 1936	199	87
Oct., 1935	195.10	93.82	Sept., 1935	140	61
1935 (Av.)	195.22	93.84	1935 (Av.)	135	58
1934 (Av.)	198.10	95.23	1934 (Av.)	114	50
1933 (Av.)	170.18	81.80	1933 (Av.)	104	27


CONTRACTS - WEEKLY AVERAGE
Current Week
Previous 4 Weeks
1936 to Date
1935 Av. for Year
0 10 20 30 40 50 60
Millions of Dollars
CUMULATIVE CAPITAL AND ENGINEERING CONSTRUCTION CONTRACTS AS REPORTED BY ENR
1935 1936
Contracts
New Capital
New capital 1935 total incl. federal
Total contracts 1935
Total contracts 1936
New capital total 1936
1936 Private investment 1935
* Federal PWA withdrawals exceeded reallotments
Millions of Dollars
PREVIOUS 4-WEEKS MOVING AVERAGE - CONSTRUCTION CONTRACTS AS REPORTED BY ENR
1936
1935
Jan Feb Mar Apr May June July Aug Sept Oct Nov Dec

Construction Equipment and Materials

Regulators

Wide pressure ranges characterize three new oxygen and acetylene regulators developed by the Linde Air Products Co. of New York City for oxy-acetylene welding. There are two oxygen regulators. One is for pressures up to 75 lb. per sq.in.; the other is designed for pressures up to 200 lb. per sq.in., but is said to be sensitive enough for welding at low gas pressures, if necessary.

The exterior design of the regulators has been simplified, and color has been used on the dials of the gages, green for oxygen and red for acetylene. Other new features include valves which close with instead of against the incoming pressure and special rubber diaphragms on both stages which are said to increase sensitivity in operation and prevent leakage.

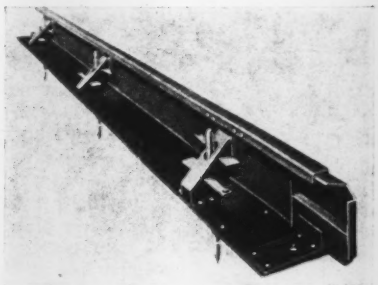
Dust Counter

To meet the need for a simple means of determining dust content in air in the control of industrial dust hazards, the Bausch & Lomb Optical Co., of Rochester, N. Y., has developed a dust counter which can be used by any foreman or engineer.

The device consists of two parts, an air sampler and a counting microscope. In the air sampler, air is drawn through a moistening chamber by an accurately calibrated hand pump of 0.001-cu.ft. capacity and the dust is deposited on a glass slide. Twelve samples may be collected on one slide. Samples may be counted at once without moving the slide or may be stored.

The viewing and counting apparatus consists of a built-in compound 200-X microscope with a special dark-field illuminating system. The microscope is fitted with an eyepiece in which there is a micrometer disk ruled in 30-micron squares. The square areas are used for counting the dust. An extra line is ruled alongside the squares to permit approximate measurement of size of particles. The apparatus is so calibrated that by multiplying the number of particles appearing in these square fields by 100,000 the total dust count per cubic foot is secured.

The device is being marketed through Willson Products, Inc., of Reading, Pa.



SELF-ALIGNING ROAD FORM

Two wedges on each of the stake pockets makes this new road form self-aligning. It is manufactured by the Blaw-Knox Co. of Pittsburgh. The upper wedge is brought into contact with the stake by hand, taking up the clearance between the wedge and the stake and eliminating movement in the form when final locking is done. The lower wedge is then driven up with a hammer for final locking. It is said this form can be set quickly and accurately even though the stake be bent or driven crooked.

Safety Belts

The American Allsafe Co. of Buffalo, N. Y., has developed a line of safety belts for construction and sewer work made from a gum-impregnated, laminated, moisture-proof fabric with a tensile strength of 6,500 lb. per sq.in. The fabric is said to have a high resistance to snagging, cutting, and abrasion.

The belt for construction workers is so designed that the weight of the body is taken on the chest and sides, preventing internal injuries. The belt is padded at the shoulders and is said to be comfortable and easily adjusted. The life-line is provided with a shock absorbing spring which permits the use of ½-in. hemp with safety rope instead of steel cable.

The tank belt for sewer work is rigged with a cross piece above the wearer's head and is so designed that the belt automatically adjusts itself to the wearer's center of gravity, making it possible to lift him straight out through the manhole in an emergency.

NEW MANGANESE-STEEL DRAGLINE CHAIN

The American Manganese Steel Co., of Chicago Heights, Ill., has redesigned their cast manganese-steel dragline bucket chain. The new design is claimed to give greater strength and less weight. The tie bar across the link prevents snarling and kinking, and the shape of the link provides full line instead of point bearing between links.

Recent Publications

• *Morse Stock* is a complete illustrated and tabulated catalog of the sprockets, chain drives, and couplings manufactured by the **Morse Chain Co.** of Ithaca, N. Y.

• **R. G. LeTourneau** of Peoria, Ill., have issued a leaflet *Power Units,* describing the power control units which operate all LeTourneau cable-controlled equipment. • **Beaver Pipe Tool Co.** of Warren, Ohio, have issued a complete catalog of their line, *Catalog No. 37.*

• *Brown Controllers* is the name of a catalog of air-operated controllers for the control of temperature, pressure, flow and liquid levels manufactured by the **Brown Instrument Co.** of Philadelphia.

• **I. L. G. Electric Ventilating Co.** of Chicago, Ill., have issued a catalog, *No. FB-45,* of their propeller fans and blowers.

• *Blasting Gully Banks with Explosives,* a pamphlet issued by **E. I. duPont de Nemours & Co.** of Wilmington, Del., contains information which should be useful in erosion control projects.

• A good deal of information about the manufacture, treatment, and chemical and physical properties of manganese steel is compressed into *The Story of Manganese Steel,* a 6-page leaflet issued by the **American Manganese Steel Co.** of Chicago Heights, Ill. • **Link-Belt Co.** of Chicago has issued a catalog of their sewage screens, *Folder No. 1587.*

• *Tego Bonded Construction* describes the use of Tego glue films in plywood construction. The book is put out by the **Resinous Products & Chemical Co.** of Philadelphia, Pa. • *Bilton Pumps,* in which the motor and the pump run on the same shaft, are described in a catalog of the Byron Jackson Co. of Bethlehem, Pa. • The use and the types of *Apex Quarry Explosives* are described in a pamphlet of that name issued by the **Atlas Powder Co.** of Wilmington, Del.

• **The Moretrench Corp.** of New York City have recently issued two pamphlets, the *Moretrench Wellpoint System* and the *Moretrench Conveying Excavator.*

• *K. O. Standard and Wide Tread Tractors* is a handsome pamphlet, printed in colors, describing the diesel tractors which are built by the Allis-Chalmers Co. of Milwaukee, Wis.

• *Tank Car Heaters and Bituminous Boosters* describes the equipment for heating bituminous products manufactured by the **Cleaver-Brooks Co.** of Milwaukee, Wis. • Power transformers and distribution transformers are cataloged in *Bulletins 181 and 180* of the **Wagner Electric Corp.** of St. Louis.

Current Construction Unit Prices

Water Supply Pipe Line, Little Rock

CONTRACT for the construction of 164,000 lin.ft. of steel cylinder reinforced concrete pipe line, with rubber gasket joints, forming another link in the extensive Little Rock, Ark. water supply project, was awarded recently. The work is under the supervision of Burns & McDonnell Engineering Co., Kansas City, Mo., and is scheduled for completion fourteen months after award of contract. Minimum hourly wage rates are stipulated as $1.12½ for skilled and 30c. for common labor. The pipe line is subject to static heads ranging from 100 to 325 ft., and the construction involves considerable rock excavation. Other contracts to be let on the same project include a dam at an estimated cost of $1,250,000, road relocation, $40,000, and clearing of the reservoir site, $60,000.

The following tabulation lists the totals and units of the three low bids of the eight submitted: (A) Lock Joint Pipe Company (contract) Ampere, N. J., $1,561,683; (B) American Concrete & Steel Pipe Co., Los Angeles, Cal., $1,697,476; (C) Price Bros. Co., Dayton, Ohio, $1,804,272.

CONCRETE WATER SUPPLY PIPE LINE, LITTLE ROCK, ARK.

Item	A	B	C
1. Trench excav. 0 to 3 ft.—8,528 lin.ft.	$0.36	$0.40	$0.45
2. Trench excav. 3 to 6 ft.—141,633 lin.ft.	.36	.50	.50
3. Trench excav. 6 to 10 ft.—11,718 lin.ft.	.61	.70	1.10
4. Trench excav. over 10 ft.—1,539 lin.ft.	1.00	1.20	1.70
5. Rock excav. trenches—61,400 cu.yd.	1.25	1.50	1.50
6. Tunnel No. 1—1,525 lin.ft.	45.00	37.50	50.00
7. Tunnel No. 2—1,068.4 lin.ft.	45.00	39.00	50.00
8. Earth excav. structures—1,871 cu.yd.	1.00	1.50	1.00
9. Rock excav. structures—880 cu.yd.	2.00	3.00	3.50
10. Pavement cut & replaced—total	4,900	4,500	15,670
11. Laboratory tests—total	5,000	5,000	5,000
12. Concrete, Cl. A—3,050 cu.yd.	17.00	24.00	18.00
13. Concrete, Cl. B—3,456 cu.yd.	11.00	24.00	16.00
14. Reinforcing steel—174,500 lb.	.05	.05	.05
15. Expansion joint assemblies—98, each	66.00	105.00	100.00
16. Pres. valve, ¼ in.—93, each	70.00	40.00	75.00
17. Pres. valve, ½ in.—17, each	70.00	50.00	75.00
18. Comb. air valve, 4x 1/8 in.—61, each	110.00	175.00	125.00
19. Comb. air valve, 6x 1 1/8 in.—5, each	168.00	235.00	200.00
20. Manholes—52, each	44.00	80.00	100.00
21. Comb. manholes, 2 in. blowoffs—29, each	47.00	90.00	100.00
22. Blowoff assemblies, 4 in.—42, each	70.00	100.00	138.00
23. Blowoff assemblies, 6 in.—13, each	94.00	115.00	160.00
24. Blowoff assemblies, 8 in.—3, each	125.00	160.00	186.00
25. Reinf. concrete drains, 18 in.—174 lin.ft.	2.35	3.15	3.00
26. Reinf. concrete drains, 24 in.—296 lin.ft.	3.18	4.00	4.50
27. Reinf. concrete drains, 36 in.—280 lin.ft.	5.50	7.00	7.00
28. Filter plant connections—total	23,450	23,000	17,401
29. Pressure break & wasteway—total	8,350	9,500	16,668
30. Control house, adj. piping—total	13,575	15,000	14,718
31. Clear right of way—total	10,000	20,000	14,186
32. Pipe & specials, 0 to 100 ft. head—34,954 lin.ft.	6.50	6.90	7.05
33. Pipe & specials, 101 to 200 ft. head—96,545 lin.ft.	6.60	6.90	7.50
34. Pipe & specials, 201 to 300 ft. head—31,584 lin.ft.	7.40	6.90	8.20
35. Pipe & specials, 301 to 400 ft. head—830 lin.ft.	8.40	7.60	10.00
36. Miscellaneous	100.00	1.00	1.00

Cape Cod Canal Revetments

CONSTRUCTION of 2 miles of retaining wall, dikes, roadway and drainage on the north bank of the Cape Cod canal at Bourne, Mass. is scheduled for 390 days completion with work starting in Sept., 1936, under the supervision of the U. S. District Engineer at Boston, Mass. The execution of the revetment work is confined to land operations due to a flat beach existing between the canal channel and the banks, with access available to the work from the new highway paralleling the north side of the canal. Spoil areas are available within a mile of the cut. The work in general consists of grading the canal bank from 5 ft. below mean low water to 10 ft. above high water, covering the slope to within 5 ft. above high water with 6 in. of crushed stone and 18 in. of hand-placed riprap; constructing a berm 20 ft. wide to receive and 18-ft. bituminous macadam roadway 10 ft. above high water level; and 800 ft. of reinforced concrete crib retaining wall.

The following tabulation lists the unit prices and totals of the three low bidders: (A) Coleman Bros. Corp. (contract) Boston, Mass. $484,984; (B) A. G. Tomasello & Son, Inc., Boston, Mass. $493,291; (C) Arute Bros. Inc., Bridgewater, Mass. $506,308.

CAPE COD CANAL REVETMENTS

Item	A	B	C
1. Excavation — 1,450,000 cu. yds.	$0.205	$0.225	$0.22
2. Riprap — 39,500 tons	2.95	2.22	2.60
3. Crushed stone — 14,000 tons	2.60	2.50	2.60
4. Broken stone, roads — 3,900 tons	2.50	4.50	3.25
5. Reinforced concrete — 67 cu. yds.	20.00	14.00	25.00
6. Plain concrete — 30 cu. yds.	10.00	12.00	25.00
7. Drop inlets — 12 each	60.00	28.00	100.00
8. Reinforced concrete pipe, 12 in.— 480 lin. ft.	1.35	1.15	2.50
9. Reinforced concrete pipe, 18 in.—880 lin. ft.	2.25	1.80	3.50
10. Reinforced concrete pipe, 36 in.—132 lin. ft.	5.00	10.00	10.00
11. Cement concrete pipe, 18 in.— 1,900 lin. ft.	1.35	1.26	3.00
12. Reinforced concrete crib wall — 333 cu. yds.	35.00	40.50	40.00
13. Bitum. asphalt — 48,484 gals.	.105	.12	.15

Repairs to Braeburn Dam

RESTORATION of the dike between the dam abutment and shoreline on the Alleghany river at Braeburn, Pa., above Pittsburgh, occasioned by the March, 1936, floods, is under way with award of contract in September 1936 to Dravo Contracting Company. As described in *ENR* April 30, 1936, the river cut around the left abutment of the dam, breaking the original shoreline for 200 ft. upstream from the abutment, and cutting into the bank in a sweeping curve, returning to the original channel 2,000 ft. downstream. The present work will complete the temporary restoration which effectively checked the undercutting of the bank. The U. S. District Engineer, Col. W. E. R. Covell, Pittsburgh, is in charge of the operation.

The unit prices and totals of the three low bidders follow: (A) Dravo Contracting Co. Pittsburgh, Pa. (contract) $158,100; (B) General Contracting Corp. & Walter S. Rae, Pittsburgh, Pa., $181,646; (C) Booth & Flinn Co., Pittsburgh, Pa. $193,218.

REPAIRS TO BRAEBURN DAM, ALLEGHENY RIVER

Item	A	B	C
1. Steel sheet piling — 40,200 sq. ft.	$1.20	$1.10	$1.20
2. Fill — 136,100 cu. yds.	.50	.65	.50
3. Derrick stone, new — 5,355 cu. yds.	4.20	6.50	9.00
4. Derrick stone, recovered — 1,000 cu. yds.	3.30	1.00	6.50
5. Riprap — 1,750 cu. yds.	5.60	6.75	7.50
6. Concrete removal — 36 cu. yds.	10.00	15.00	10.00
7. Concrete — 185 cu. yds.	18.00	16.00	23.00
8. Steel reinforcing — 750 lbs.	.06	.06	.10
9. Rubble masonry — 87 cu. yds.	16.00	16.00	18.50
10. Corr. metal pipe, 48 in.— 156 lin. ft.	7.00	9.00	18.00